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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

SCIENCE AND TECHNOLOGY

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ABSTRACTS

NATIONAL DEVELOPMENTS

NEW RESEARCH POLICY VIEWED BY SWEDISH DIPLOMAT

Stockholm UTLANDS RAPPORT in Swedish No 8502, Oct 85 pp 3-18

[Report by Christer Nilsson of the Office of the Technical-Scientific Attache at the Swedish Embassy in Beijing: "China's New Research Policy"]

[Text] Table of Contents

1. Introduction

China's economy is now developing rapidly. The reason for that development is to be found in the reforms that have been carried out since 1978, when the new program for the country's modernization was adopted. Agriculture was the first sector to be reformed by introduction of the so-called responsibility system. The result was a rapid improvement in the rural standard of living, at least in areas with good conditions for agriculture.

In the fall of 1984, it was the turn of the cities. The Central Committee's decision to reorganize the economic structure in the cities on the analogy of the rural reform was published in October of that year. The basic idea behind the reform was to increase the efficiency of administration, trade, and industry. This was to be done partly by increasing material incentives, giving management greater responsibility as well as the correspondingly greater right to decide on the use of its profits, and adopting business models which in some cases show great similarity with capitalist models.

Key issues in the development of urban economies are, of course, the level of scientific and technical research and the ability to apply the results of that research. Science and technology constituted one of the priority areas in the "four modernizations" program. A plan for modernizing the country's science and technology had been adopted in April 1978. It stipulated the way in which China was to transform its organizations, create the necessary personnel resources, and allocate more money to research. Jon Sigurdson wrote in an article published in "Technology in the World: China" (Engineers Publishing House, 1982): "Today it is possible to see the shortcomings in the new effort, but also to see the outlines of a changed and more realistic research policy.

"In comparison with Japan, China has not yet coped successfully with the first of the three steps to technological development (technology imports and licensing agreements). It was not long after the long-term plan was adopted that members of the government and politicians concerned with research awoke to their own limitations. But it was to take much longer than they expected to produce the large number of new researchers and technicians needed, not only because the technical institutes had lain fallow during the Cultural Revolution but also because it takes a long time to build up a tradition of research and produce competent researchers in new areas."

Sigurdson also says that a special school on research policy and organization was opened in the summer of 1979 for top men in China's government and party. The next step, Sigurdson says, must be to use researchers effectively in industry, agriculture, and other economic activities.

An international conference on "Science and Technology Policy and Research Management" was held in Beijing in October 1983. Its organizers were China's State Science and Technology Commission (SSTC) and the United Nations Financing System for Science and Technology for Development (UNFSSTD). That conference must be viewed as an expression of the great importance assigned by the Chinese Government to planning and management issues even in the area of science and technology.

During the conference, emphasis was placed on the importance of specific plans in the area of science and technology to ensure rapid national development. Premier Zhao Ziyang said in a speech at the conference that it was the government's express policy to link technology policy and scientific planning together with plans for national economic and social development. That policy now finds specific expression in a special agency called the State Science and Technology Planning Office, which serves both the SSTC and the State Planning Commission. Moreover, the ministers for both commissions are also members of the State Council, which is also supported by an influential advisory agency known as the Science and Technology Leading Group, whose chairman is the premier himself.

Also discussed at the conference were questions concerned with financing and with methods for ensuring balance between basic and applied research. In many developing countries with few economic resources, a concentration on directly usable research is understandable. More fundamental research, even if bound up with technological needs, must be financed by the state budget, and that is not always possible. But countries which neglect such research have difficulty later in appropriating technology transfers.

Also presented at the conference was a report on early experience with an experiment with contract research. For several months, 53 out of 77 research institutes in Nanjing had worked for industry under contract. During that short time, they had earned back about 60 percent of the annual state appropriation. We will discuss that form of activity in more detail later in this report.

Personnel matters were also dealt with. Younger researchers should be given more support--currently they are often not utilized during their most creative period. To stimulate researchers--and thereby stimulate research as well--there should be greater mobility. At many institutes, the research situation was too static, partly because of the rigidity that appears when personnel turnover is low. As a consequence of that, researchers at many institutes were underemployed and insufficiently stimulated.

In conclusion, I would like to refer to the report written by the former technical attache in Beijing, Ola Svensson, in 1983 under the title "Chinese Technology, Science, and Research Policy" (STATT [Swedish Technical Attache Report] No 8302). That report provides the background to the reform that was recently implemented.

The material for this report was taken primarily from the document issued by the National People's Congress this year and from newspaper articles on the subject.

2. Preparations for Research Reform

During the National People's Congress held in March of this year, there was discussion concerning research policy and management questions in the area of science and technology. The top state leadership, headed by Premier Zhao Ziyang, took an active part in the discussion. The National People's Congress

had been preceded by a series of talks with the research organizations, chiefly the SSTC and the Chinese Academy of Sciences (CAS). Those talks had resulted in agreement that the link between scientific research and national development must be strengthened.

In January of this year, for example, the party's secretary general, Hu Yaobang, had discussed the coming reform with a group of researchers and promised that their viewpoints and suggestions would be included in the final proposal. Hu urged the researchers to adapt their research more closely in the future to the country's needs during the period of modernization.

The Academy of Sciences also held its annual congress in January. Lu Jiaxi, chairman of the academy, emphasized in a speech that scientific and technological projects linked to the country's development would now be one of the academy's priorities. That marked a striking departure from previous attitudes, which had shown a preference for pure basic research. Lu stated, however, that over the previous few years the academy had participated in some of the country's key projects in agriculture, land resource use, protection of the environment, new materials, and biochemical technology. Four additional priority areas were mentioned at the conference:

a) The development of new science and technology for the new branches of industry now springing up.

b) Advanced theoretical research so as not to fall behind the developed countries.

c) Support for individuals with a talent for science and technology.

d) Advisory service to the government in the scientific area.

A conference held during the first week of March this year included participation by Deng Xiaopeng himself (the "senior leader," as his title is usually but vaguely rendered), who asserted that the current reorganization of the economic system would also have a favorable influence on the development of science and technology. Conversely, the coming reform in the area of science would promote economic growth. Deng also asserted that the most important single factor in reorganization of the management system both in the economy and in science was talented individuals.

Here it can be interjected that at a similar conference as far back as 7 years before, Deng had said that science and technology should be regarded as productive forces and that China's intellectuals were to be viewed as "members of the working class." That latter classification had helped put an end to the attacks on intellectuals.

State Councilor Fang Yi, who presided over the conference, said that the reform would have far-reaching consequences, since it concerned 6 million researchers and technicians and more than 9,000 research institutes all over the country. We will have more to say about this as we discuss the various points in the reform.

3. Content of New Reform

Then at the National People's Congress in March 1985, a resolution on a reform of science and technology was adopted. Premier Zhao Ziyang said in his speech on that subject that "to obtain better results in the work with the four modernizations and prepare ourselves for the technological revolution, the technological-scientific system ought to be changed."

The old system had a serious drawback, said Zhao, in that it separated science and technology from production. It was also too clumsy because of massive central planning and inflexible working methods.

The new policy adopted at the National People's Congress can be summed up in nine points:

1. Scientific and technological research shall serve China's modernization efforts.

2. The system of allocating funds to research institutes is to be reformed.

3. A market for technology is to be developed, with a price being placed on research results and technological advances.

4. The technological-scientific system is to be reorganized to provide a stronger tie between research, training, design offices, and production units.

5. Agricultural science and technology are to be reformed.

6. There is to be a steady concentration on basic and applied research.

7. The research institutes are to be given greater decisionmaking authority, and at the same time, overall planning at the government level is to be improved.

8. The door to foreign research will be kept open.

9. Personnel policy is to be reformed.

Those nine points are discussed in more detail below.

3.1 Research Must Serve Country's Modernization

According to the goals adopted, China's industrial and agricultural production is to quadruple by the year 2000 (in terms of 1980). That is part of what was previously called "the struggle for the four modernizations." It is so well known that further comment is scarcely required. That goal has obviously been set very high, and many observers consider its achievement unlikely. It is perfectly clear, however, that economic and technological development in China has been making good headway and that a turning back is hardly likely. It is probable that the current rapid rate of growth in development will slacken, but that the main thrust will continue.

It is stipulated in the resolution by the People's Congress that "the main task of the party and the entire people is to stimulate the economy and implement the four modernizations. Scientific and technological work must be focused on and serve that main task."

3.2 System of Appropriations

This part of the reform is important. For a start, the central role of research will be emphasized by an increase in general appropriations for scientific research and technological development at both the central and the local level. This increase will also be larger than the average increase in other general expenditures.

The system of appropriations will then be reorganized in such a way that an increasing number of research institutes will be financed by other means. Institutions of various kinds, industries, and social groups will be encouraged to invest in technological and scientific research.

Major scientific and technological research and development projects and the establishment of laboratories and development departments in key research areas included in central and local plans will continue to be financed through central and local appropriations. But in the planning and administration of research--and this is what is new--it is also necessary to use economic control mechanisms, apply the theory of value, and gradually introduce such management methods as public tenders and commissioned research (initially on an experimental basis).

A system of contract work will gradually be introduced into technological development and applied research projects that promise an immediate practical return. Independent research institutes, which are concerned primarily with such research and development work, should themselves earn money and build up funds by contracting for state-planned projects or research projects on behalf of other organizations, sell their technological results, join in joint ventures for technological development, participate in cooperative projects for export, and provide consulting services.

That portion of operating expenditures now borne by the state will gradually be reduced with a view to making most of those research institutes economically independent within from 3 to 5 years' time. The money thus saved by the state will be used to support research and development in other ways.

A system of science foundations for certain types of applied research projects will be established on an experimental basis. Their funds will be provided mainly by the state. A national foundation for natural science and other foundations for scientific and technological research will be set up. Researchers and institutes will be able without restriction to apply to those foundations for funds to finance research projects. Then the foundations will select the "best" projects on the basis of national plans for scientific and technological development. But applicants will not be able to count on having all their costs covered from that source. In general, they will have to rely on other sources of funds as well.

The more complex an institute's research program is, the more varied will be its financing. Here the banks will also enter the pictures, since it will also be possible to finance research projects through bank loans.

This type of thinking--new for China--did not come out of nowhere. Foreign experiences have naturally been among the sources of inspiration. Experiments on a rather large scale have also been underway over the past few years. A report in the BEIJING REVIEW (No 11, 1985) says that 505 research institutes (about 6 percent of the total number) have been working under a contract system on a trial basis for the past 2 years. According to that periodical, the result has already been increased scientific production, higher profits ("profits" being indeed an obvious concept in view of the "change of system"), and less dependence on state appropriations.

On 5 April 1985, it was announced by the Academy of Sciences (CAS--not to be confused with the Academy of Social Sciences, or CASS) that of 1,274 completed research projects, more than half had been applied to production. That is a considerably higher figure than had normally been the case before (10 percent, according to one source). As examples of such applications, the CAS mentions technologies concerned with energy, computer applications, and biotechnology.

In December 1984, the academy signed a contract with Hunan Province regarding the transfer of research findings useful for local economic development and for use of the province's natural resources. A joint company for technology development and the exchange of information is to be set up.

In August 1985, the academy also announced that funds had been established within that framework for both basic and applied research. Nearly 1,000 applications for subsidies totaling 110 million yuan had been submitted. The applications had been examined by 3,000 experts, who had approved 656 projects for a total of 34 million yuan. Even more funds will be available in 1986, and a number of important general projects will be carried out. But that type of project, which requires a lot in the way of funds, will gradually come to be financed by other science foundations.

3.3 Technology Markets

A technology market is to be created, with technological and scientific results being assigned a price and sold. The document from the People's Congress says: "Technology and science are primarily products of the human intellect, and the value thus created should be fully recognized and fixed.... More and more technologies have become products with intrinsic value, and a new industry concerned with knowledge has developed. That market for technology constitutes an essential part of our country's socialist market."

The results of technological research are therefore being assigned a price and sold on the technology market. The price is determined by negotiation with no interference by the state. Protecting the rights of buyers, sellers, and agents requires a developed system of laws, rules, and regulations. Those laws and regulations are now coming into being at a rapid rate. This is virgin ground in China, which previously had no such tradition.

The new patent law has been in effect since 1 April 1985. A copyright law is being drawn up. Regulations governing technology transfers from abroad were adopted in May 1985. Work is also underway on a law to regulate contracts concerned with technology. That work should be completed by the end of 1985.

A number of technology markets (in the very literal sense) were held all over the country in May and June of 1985. They are said to have been very successful. The CHINA DAILY reported on 12 June, for example, that over 4,000 purchase agreements had been signed during the month-long market in Beijing. Over 10,000 other agreements worth about 8 billion yuan had also been signed. About 1,500 technological results, services, and new products had been for sale at that market.

Those figures seem very high and must be taken with a grain of salt. Another report (in the CHINA DAILY, 1 October 1985) states that 240 technology markets have been held over the past 2 years and that the total value of the resulting contracts exceeds 10 billion yuan. Unfortunately, it is difficult to verify that kind of information in China.

Markets like these are now going to be held every year. Moreover, 1,100 permanent centers for technology exchange and 3,000 consulting offices have been set up (as of June 1985--the number is probably increasing rapidly!). Plans call for also inviting interested parties from abroad to next year's technology market in Beijing.

3.4 Reorganization of Technological-Scientific System

The document says: "We should reorganize the technological-scientific system, encourage a closer connection between research, training, design departments, and production units, and increase the ability of firms to take advantage of technological applications and technological development."

This is to be achieved through closer cooperation between research institutes and industry. Both parties are to be encouraged to participate in various forms of cooperation to the benefit of both. To begin with, it will be possible to develop informal forms of cooperation into economic units able to stand on their own. It is conceivable that some research institutes will develop into enterprises involved in both research and production. Larger firms and some medium-sized firms should have their own R&D departments.

An enterprise will be allowed to set aside a portion of its pretax profits for that purpose in accordance with special state rules. Its ability to take advantage of technological development to improve its economic efficiency will be an important factor when its overall activity is being assessed.

Here we should also mention that military research institutes will also make their resources and research results available for civilian use to a greater extent than before.

To hasten the development of new industry, special attention should be paid to a few regions that have especially good resources as far as intellectual

workers are concerned. Those areas will gradually be turned into industrial development zones with varying characteristics. What this means in particular is not completely clear.

3.5 Agricultural Sector

"We will transform the technological-scientific system in the agricultural sector so as to better serve the adaptation of the rural economic structure and promote economic changes in the direction of specialization, large-scale production of goods, and modernization."

What was said earlier about research in general also applies here, but the singling out of agriculture in this way puts it in a favored position.

3.6 Steady Concentration on Basic and Applied Research

Parallel with the concentration on technological development, there should also be a strengthening of applied research and assured steady development of basic research. There is awareness that breakthroughs in basic research often lead to the development of new technologies and that that process is tending to move more and more quickly. Basic research must therefore not be neglected. In this area, responsibility is being placed primarily on the Academy of Sciences and the technical colleges. Cooperative projects among various institutions will be encouraged. Since research is closely related to training, institutions of higher education will devote themselves to such activity to a greater extent than before.

3.7 More Decisionmaking Power for Research Institutes

"The research institutes will be guaranteed greater decisionmaking power. Overall management of the technological and scientific area will be improved."

The resolution by the congress conjures up a picture of independent institutes directing their research toward socially important areas and having the initiative in their own hands. With the exception of certain research tasks that may be assigned by the state and the choice of manager or director, who is appointed by higher authority, the institutes make their own decisions. Naturally, they must do so within the framework established by society in the form of laws, regulations, overall plans, personnel policy, and so on. This means in particular that the institutes are in control of their own net incomes (appropriations from higher authorities are therefore excepted). That money can be used for new research projects, social expenses for personnel, bonuses, and so on. The degree of freedom to be enjoyed by each specific institute will be determined to a large extent by the level of self-financing it has achieved. But government regulations concerning pay scales and bonuses must be followed.

The head of each institute is responsible for its activity. Also emphasized is the fact that it is important for scientific and technical personnel to exercise influence over operations. This will be put into effect through various kinds of responsibility systems. A project leader has great influence

in such a system. Personnel in the project can be hired by the project leader or brought into the project under freer arrangements ("free association").

An institute's party organizations, which periodically become so influential, also remain in the picture. But the party secretary will have to have some degree of scientific training. It is emphasized that real power belongs to the manager or director and that the party section's task will be "to oversee and promote scientific and technological work through ideological and political work." In particular, the party secretary will see to it that the party's new policy regarding intellectuals is obeyed.

Groups or individuals will be allowed to set up scientific and technological service organizations. Local authorities will supervise that activity and also provide leadership and assistance. If such organizations are started as profit-making bodies, they are to be registered as such with the appropriate local authority.

3.8 Open Door

"Opening the door to the surrounding world so as to establish contact with other countries is China's basic long-range policy when it comes to developing its science and technology."

The important role played by technology imports in developing China's production apparatus and building up existing industries is emphasized. It is stated in particular that the four special economic zones and the 14 coastal cities should use their privileged position on behalf of such technology imports. Special importance is assigned to the importing of patents, know-how, and software. Imported advanced technology is to be absorbed by the system itself in order to increase the development capability of its own production technology. Technological development projects with a chance of competing on the international market will be given special support so that they can begin that competition in as short a time as possible.

International academic exchange is to be actively supported and expanded: prominent researchers and engineers will receive assistance making it possible for them to participate in international research projects, the number of people sent abroad for purposes of study, advanced training, or practical experience or on trips to learn about technology will be increased, foreign specialists and researchers will be invited to work in China, and so on.

In that spirit, the Chinese Academy of Sciences (CAS) has decided to open 17 of its laboratories and two research institutes to foreign researchers. The institutes are the Theoretical Physics Institute and the Institute of Mathematics, both in Beijing. Some of the laboratories are the following: the Structural Chemistry Laboratory at the Fujian Institute of Research on the Structure of Matter; the Vacuum Physics Laboratory in Beijing; the Geomechanics Laboratory at the Institute of Mechanics in Beijing; laboratories for ion and infrared physics in Shanghai; and the Laser Spectrum Laboratory at the Anhui Institute of Optics and Fine Mechanics.

The academy has drawn up regulations for the management of those laboratories and has invited prominent scientists to head the laboratories and scientific committees associated with them. Chinese and foreign researchers can apply to those committees for research projects. Following committee approval, they can carry out their projects with financial support from the committee.

China will also work actively to gain access to international computerized information retrieval systems, increase its imports of scientific and technological literature, and, in general, speed up exchanges of scientific and technological information so that the country can stay well informed concerning international developments.

3.9 Personnel Policy

"We must reform the administrative system for scientific and technological personnel so as to create a good environment in which a large cadre of qualified personnel can be trained and in which individuals can give free vent to their creative ability."

That is definitely a new sound in modern China. There has scarcely ever been a period in the short history of the PRC when intellectuals were well regarded. Many intellectuals were subjected to ferocious persecution during the Cultural Revolution. In fact, many of them paid for their background with their lives. Now the very important role played by intellectuals in the country's development is fully recognized.

Work in academic and technological research will be strengthened by placing a large number of young and middle-aged researchers who are professionally trained and energetic in influential positions. And there must be no hesitation in pushing the most talented young people forward. Great efforts will be made to train administrators of various kinds in natural science and technology so as to improve the management of research.

Talented researchers must not be held back. Instead, they are to be promoted to higher positions where they can manifest their talents. Mobility must increase. Until now, the personnel situation has been very static at nearly all research institutions. The density of teacher-researchers at universities is frequently such that there is one teacher for every three students. As a result, there have often been complaints that there are not enough work and research assignments for everyone. The intention now is to remedy that situation through a freer flow of personnel within and among research institutes and technical colleges. The less restricted use of funds and the general improvement that is already noticeable in the research climate are also helping to rectify the problem.

As was indicated earlier, pay, rewards, and honors will be used to a greater extent than before to encourage greater research efforts. Anyone making an important contribution to an institute's work is to be abundantly rewarded.

Against the background of the bitter experiences of the Cultural Revolution, very strong emphasis is also being placed now on the importance of free

academic discussion--that free discussion is one of the cornerstones of research.

4. Conclusion

It is still too early to express an opinion on how far the reform of scientific and technological research that I have just described is going to penetrate. The experiences reported so far are an unmistakable indication, however, that the research climate has improved wherever the new working methods have been tried. Whether the intention to make most of the research institutes self-sufficient within the short period of 5 years will be successful remains to be seen.

In conclusion, however, I would like to mention a few recent reports on the effects of the reform.

One of the places where the new system was tried out as an experiment last year was the Shanghai Institute of Textile Science. The deputy managing director, Hu Jiafu, says that during 1984 the institute signed 200 contracts concerned with technological development. And 51 projects were completed during the year (compared to 22 the year before that).

Jin Zhuqing, chairman of the Shanghai Commission for Science and Technology, now states (in September 1985) that 58 of the city's 803 institutes of applied research are currently working according to the guidelines in the reform and that the others are scheduled to become financially independent within 5 years. Jin also says that during 1984, Shanghai's researchers reported 1,585 research results, half of which have already been applied in practice. Those good results must be attributed, at least in part, to the experimental activity based on the new management methods.

To facilitate the dissemination of research results, the SSTC has established a national marketing development center. That center will organize technology markets, promote the exchange of technical-scientific information among various organizations, and provide consulting services in connection with loans, patents, and legal matters.

The center will also work to make scientific and technological conquests on the international technology market.

It is clear that the opportunities for foreign researchers to obtain information about and even participate personally in this new growth in the field of research have increased considerably. Chinese researchers are also very eager to establish contact with foreign colleagues. It is recommended that Swedish researchers wishing to establish contact with Chinese research get in touch with the Swedish Technical Attaches (STATT), the Swedish Academy of Engineering Sciences (IVA), or the Royal Academy of Sciences (KVA).

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NATIONAL DEVELOPMENTS

FORECAST FOR ENVIRONMENT IN CHINA BY YEAR 2000

HK230549 Beijing JINGJI RIBAO in Chinese 13 Nov 85 p 3

[Article by Qu Geping [2575 2706 1627] of the "China's Environment in the Year 2000" Research Group: "China's Environment in the Year 2000"]

[Text] The article "China's Environment in the Year 2000" is a forecast of the prospects of the development of our country's environment. This forecast has been made through proceeding from a research into the world environment situation and the current situation of environment problems in our country, taking into account our economic development, resource utilization, population growth, and technological progress, and also taking into consideration the impact of the economic structural reform and the new technological revolution. It also sets out the target of environmental protection and the strategic policy for the year 2000.

I

At present, there exist simultaneously environmental problems of ecological disruption and environmental pollution in our country, both of which are fairly serious. This is a critical problem in our economic development.

--The serious destruction of our natural ecological environment has already become an outstanding environmental problem. This is mainly shown in the disruption of the vegetation, soil erosion, the salinization of soil, the growth of deserts, and the abnormal weather, which have caused a decline in the productive forces of our farmland, forests, grassland, and our natural ecological systems such as rivers, lakes, seas, and underground water.

--There is agricultural environmental pollution all over our country.

--In many areas in our country water pollution is serious and the contradiction between the continuously increasing demand for water and the limited water resources has become increasingly sharp.

--Atmospheric pollution, mainly caused by dust and sulphur dioxide yielded by burning coal, is very serious, particularly in our large and medium-sized cities.

--About 40 percent of our urban population live in an environment with greater noise than the standard limit.

--In 1980, our industry released over 400 million metric tons of waste, of which less than one-fourth was comprehensively utilized.

--Environmental pollution has caused serious harm to people's health.

II

According to our forecast, the environmental situation in our country in the year of 2000 will be as follows:

1. The trend of the disruption of the natural and ecoological environment will be difficult to reverse in a short time, but it will tend to gradually ease. Some aspects of the disruption will be basically controlled and some aspects of the environment will be improved.

2. By the year 2000, agricultural environmental pollution will continue to develop, but the pollution caused by organic chloride pesticide to our soil and agricultural and livestock products will be overcome.

3. By the year 2000, the environmental and industrial pollution in our urban areas will be controlled to some extent and improved.

4. By the year 2000, as we will have controlled industrial pollution and selected key areas to focus our efforts on improving our urban environment, in some aspects, the harm done by environmental pollution to people's health will gradually be reduced.

--Compared with now, the harm done by atmospheric pollution will be reduced.

--Infectious intestional diseases that spread through water will be controlled and the incidence of these diseases will drop by 30-70 percent.

--Before 1995, the impact of environmental pollution on the death rate of our population will grow, but by the year 2000, the death rate resulting from environmental pollution will be 0.74 per 1,000 less than that in 1995.

--Under the comprehensive influence of various factors, including an improvement in the environment, average life expectancy will rise.

In order to attain the above-mentioned limited targets for environmental improvement by the year 2000, it is necessary to spend 1-1.5 percent of our national income on handling environmental problems. If we allocate 1 percent of our national income for the handling of environmental problems, we will basically control pollution and prevent it from worsening. If we spend 1.5 percent of our national income for this purpose, by the year 2000, there will to a certain extent be improvement in our environment. Our calculation shows that even if we spend 1.5 percent of our national income on handling

the problems related to our environment, this will not hinder our attainment of the strategic goal of quadrupling our gross industrial and agricultural output value and pushing up our per capita consumption to a comparatively well-off level by the year 2000.

III

The principal contradictions in tackling environmental pollution are:

--The contradiction between economic development and environmental pollution. In the process of modernization, serious environmental pollution and disruption have emerged in nearly all industrially developed countries, which have paid tremendously high economic and social prices for their modernization. If we now overlook the environmental problems, by 1990, we will perhaps be in difficulties. In handling the contradiction between the economy and the enrivonment, we are encountering the following two major problems: One is that some of our policymakers lack sufficient understanding of the significance of environmental protection and fail to regard environmental issues as vital to our sustained social and economic development; and the other is that we regard the work of environmental protection merely as a professional work with a narrow involvement. The gaps caused by departmental economies and the practice of various areas each acting in its own way make it very difficult to actually implement comprehensive measures for handling environmental problems, and make it impossible for us to fully and rationally utilize our limited resources.

--The contradiction between our weak economic foundation and our heavy tasks in handling environmental problems. The degree of pollution in our country at present is the same as that of the industrially developed countries in the 1960's, when environmental pollution there was widespread and serious. At present we have failed to do many things that we ought to have done long ago, but for a fairly long time to come, the state will not be able to allocate much money to tackle the pollution problems. This contradiction determines that we must find ways with Chinese characteristics to raise funds for this purpose and to prevent and overcome pollution.

--The contradiction between the development of our township and twon industry and environment pollution. As township and town industry develops all over our country, by the year 2000, its output value will increase by nearly 600 percent. These enterprises are large in number, spread over a vast area, have backward management and technology, and are mostly not equipped with pollution prevention facilities. If we fail to adopt a policy toward these enterprises, environmental pollution in our country will spread from small and scattered urban areas to the vast areas in our countryside and thus aggravate the distruption of our national ecological environment.

There are in addition two contradictions in our work of establishing a good environment. The first is the contradiction between our goal of quadrupling our industrial and agricultural production value on the one hand and the serious water pollution and the aggravating shortage of water resources on

the other. This problem is particularly serious in northern, northwestern, and, northeastern China. The second is the contradiction between the policy of using coal as the major source of energy and atmospheric pollution. This makes the work of overcoming atmospheric pollution even more complicated and money-consuming.

IV

We should adopt the following strategic environmental policies:

--We should implement thepolicy of simultaneously developing our economic construction, urban and rural construction, and environmental construction.

--We should earnestly include the tasks of environmental protection in our national economic plans at various levels, regard the environmental protection targets as an important basis for assessing and evaluating the work results of various departments and enterprises, ensure that the channel for the circulation of funds is not blocked, and strengthen environmental control.

--We should follow the path of "combining prevention with the work of overcoming pollution, regarding prevention as the core and adopting comprehensive methods to overcome pollution," and avoid repeating previous errors of "first allowing pollution and then trying to find ways to overcome it."

--We should persist in drawing up all-round plans and having a rational layout of our industry, properly evaluate the impact of our projects on the environment, and implement the stipulation of "simultaneously developing, economic, urban and rural construction." Our old enterprises should combine the adoption of pollution prevention measures with their technological transformation. We should readjust the orientation of the development of our township and town enterprises and the enterprises of our neighborhood organizations, and resolutely prevent pollution from spreading from our urban to rural areas. We should gradually switch from technical to planned prevention of environmental pollution.

--We should adhere to the principle of "those who cause pollution tackle the pollution and those who exploit resources protect the environment."

--We should give play to the initiative of all sectors, divide up the tasks among all sectors, raise funds for environmental protection in many ways, and thus reduce the financial burdens of the state.

--We should establish an environmental control strategy that centered on environmental protection. We should encourage the adoption of new technology, do our best to turn resources into products, and reduce the discharge of waste materials. We should rationally exploit and protect our land and water resources and protect our forests, grassland, and wild animals and plants.

--We should carry out scientific and technological policies that are conducive to environmental protection, and give full play to the role of modern science and technology, particularly biological engineering, in protecting the environment.

We should encourage combining advanced with medium-level technology, and apply new technology to the exploitation of resources, environmental management, and pollution control. In our industrial and agricultural production, we should encourage combining economic design, sense of production, and sense of ecology. We should conduct research into and apply new production technology and thus turn organic waste into energy and inorganic waste into resources.

--We should draw up and perfect environmental protection laws and standards, and revise some of the existing policies that are detrimental to the protection of the environment and natural resources.

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CSO: 4010/18

NATIONAL DEVELOPMENTS

REFORM OF BEIJING S&T SYSTEM DISCUSSED

Beijing KEJIBAO in Chinese 28 Oct 85 p 1

[Article by Lu Yucheng [7120 1342 3397], Chairman of Beijing Municipal Science and Technology Committee: "Status and Tasks of the Reform of Beijing's Science and Technology System"]

[Text] In keeping with the CPC Central Committee Resolution on Reform of the Science and Technology System and the instructions of the municipal party committee and the municipal government, and by means of the common efforts of comrades in all independent scientific research organizations subordinate to the city and all committees, offices, bureaus (or head corporations), following the trial implementation of the research responsibility system and compensation contract system in the last few years the reform of the city's science and technology system has made an important and gratifying step: as of mid-October, all municipally subordinate independent scientific research organizations in the city (except for three that are newly constructed or under construction) have instituted comprehensive reform by completely changing over to three different forms and methods, the technology contracting system, the operating expenses contracting system and the arrangement of "two systems in one institute."

The beginning of comprehensive reform of independent scientific research organizations subordinate to the city is an important indicator of the excellent situation in Beijing's reform of its science and technology system and a new point of departure in our comprehensive implementation of the Central Committee resolution. Below I offer a few opinions on the current status and tasks of Beijing's reform of its science and technology system.

I. Current Status of Beijing's Reform of Its Science and Technology System

The reform of our science and technology system has been proceeding steadily for several years and has posted outstanding achievements, some of which are described below.

1. The independent scientific research academies and institutes subordinate to the city have conducted spot experiments and dissemination of the research responsibility system and the compensation contract system, but they have

begun the comprehensive reforms of the three types cited above only recently. It has been nearly 4 years since four research institutes introduced the research responsibility system on a trial basis in 1981. Three major steps have been taken in the 4 years, which is not a slow pace.

The scientific research responsibility system was announced to deal with some long-standing abuses in research organizations in accordance with the spirit of the Central Committee's reforms. It includes a requirement that the research units sign overall contracting agreements with their cognizant higher-level offices regarding topics, results, transfer of results, and income, and that internally they interrelate responsibilities, rights, and benefits and calculate compensation in terms of results and benefits in terms of effort. The provisional implementation of this measure was a start in correcting the situation of "eating out of the same pot" and the egalitarianism that existed in the research units, and in motivating scientific and technical personnel and linking scientific research more closely to production.

In accordance with Premier Zhao's important directive regarding the compensation contract system, last year, after instituting the responsibility system, we conducted spot experiments with the compensation contract system in several research units engaged in technology development. We required that they decrease their operating expenses every year so as ultimately to achieve economic independence, and in addition we instituted a preferential policy to encourage them to orient themselves [toward certain producers] and link themselves [to production]. Based on this guiding idea, last year the municipal government issued Beijing Government Notice No 99, which announced the granting of 10 rights and required that scientific research units, while acting in accordance with state planning and management, gradually achieve the "three independences and one contract," i.e., economic independence, operating independence, freedom in their field of specialization, and topic contracting. Because the research responsibility system had already been trial-implemented for several years, the conversion to the compensation contract system reform followed from it rather logically.

In May of this year, past experience was summarized at a citywide science and technology work conference, the city's science and technology system reform activities were laid out in keeping with the spirit of the resolution, and a realistic, category-by-category, gradual citywide implementation of reform was called for. As a result of more than half a year's effort, the independent scientific research organizations subordinate to the city have all taken their places and begun the reform.

2. Experience shows that the reforms have increased the sense of urgency, drive, and flexibility with which a large number of research academies and institutes have oriented themselves toward economic construction.

Thirty-two units in the city that had engaged in spot experiments with the compensation contract system followed up last year's major progress by continuing to develop the excellent reform situation this year. A survey of

30 of these units indicates that in the first half of this year they obtained about 5 million yuan in research expenses from the higher levels, while the earnings that they arranged for themselves totaled 28 million yuan, of which 64 percent was production income, a slight increase from the previous year, while their technology-related income of 10 million yuan accounted for 36 percent of the total, 10 times last year's figure. In addition, a survey of 64 research units subordinate to the city indicated that in the first half of this year they signed 222 technical contracts with manufacturing and mining enterprises worth a total of 9.54 million yuan.

The resolution states that the fundamental goal of reform of the science and technology system is to get scientific and technical innovations applied in production more rapidly and extensively, to assure that scientific and technical personnel are thoroughly utilized, to liberate scientific and technical productive forces on a large scale and to promote economic and social development. Extensive experience has shown that our reform is entirely in accordance with this basic spirit. In the first half-year, the municipal Chemical Engineering Research Academy began work on 76 projects, up 8.6 percent from the same period last year. The academy's net income was 3.8 million yuan, 3.3 times the figure for the same period last year. Since the city's Powder Metallurgy Research Institute introduced the reforms, it has intensified technological development and technology dissemination; in the first 8 months of this year its technology-related earnings were 1.7 million yuan, an increase of 60 percent from the same period last year. In the 24 years from 1959 to 1983, the city's agricultural machinery institute had produced only 60-odd innovations, an average of fewer than 3 a year; last year, following the reform, it completed 31 scientific and technical innovations and engineering designs in a period of slightly more than a year, earning 240,000 yuan, 5 times the figure for the 3-year period 1981-1983.

3. Economic construction must rely on science and technology, and science and technology must orient themselves toward economic construction. As the reform of the economic system and of the science and technology system penetrates deeper and deeper, as the enterprises' requirements for technological progress become more pressing, as the technology markets improve and expand, and as the research units' awareness of the importance of orienting themselves and ability to orient themselves increase, they are gradually sorting out the relationship of science and technology to the economy and the reform of the science and technology system is in unprecedentedly good condition.

This year, research and production combines have been appearing in profusion; incomplete statistics indicate that there are already 488 citywide.

4. Another important manifestation of the excellent situation in Beijing's reform of its science and technology system is the importance that the municipal party committee and municipal government leadership attach to it and the energetic support given it by the relevant committees, offices, bureaus (financial, taxation, labor and personnel) and banks. The municipal party committee leadership has repeatedly encouraged and urged us to accelerate the

pace of the reform and to have all research institutes subordinate to the city carry out comprehensive reform this year with no further delay. In addition they have repeatedly requested certain integrated departments, particularly the finance, taxation, and labor departments, banks and the like, to give support and assistance. Last year's municipal government document No 99 had a major effect in promoting trial implementation of the compensation contract system; this year we have issued another 8 or 9 documents, thus assuring smooth progress this year in the reform of the science and technology system.

To summarize, the reform of the science and technology system began rather early, was carried out on a large scale, and has produced good results; there are many favorable conditions in all areas, so that we should be able to do even better. Although we have already had all of the research institutes subordinate to the city introduce comprehensive reform ahead of schedule in accordance with the request of the municipal party committee and the city government, the following problems still exist in implementing the resolution.

a. The scope of the reform is still insufficient.

In the last few years we focused on reform of science and technology organizations subordinate to the city, which was in keeping with the spirit of the Central Committee's slogan "caution at the outset in order to assure victory." But as the reform of the economic system deepens and the capital's economic construction and municipal construction continue to develop, the reform of the science and technology system must increase its pace further.

The industrial departments currently have more than 90 research academies and institutes, including 34 second-level company research institutes and more than 40 plant institutes. These institutes were set up gradually during the development of Beijing's industry, and in the past they made a positive contribution to Beijing's industrial development. But now they are in great difficulty as regards funds, facilities and personnel, their tax burden is too heavy, they lack needed autonomy, and there is an urgent need for reform so that they can develop the capabilities, drive, and flexibility for development of their branches of industry.

b. The relationship between reliance and orientation must be further rationalized.

The core problem in the Central Committee resolution is to achieve reliance and orientation. The research academies and institutes are now becoming more flexible and are producing more results, but the "outflow" of these results [outside the city] is rather serious. There are many reasons for this outflow, and they require specific analysis. In general, one of the factors is that the level of the research results is not high, and they are suitable only for rural enterprises, particularly those in the hinterlands. The outflow of these results is not a bad thing, I believe; it has the advantage of accumulating funds for the research institutes. The second reason is that the enterprises have long been accustomed to adopting innovations without compensation, and

they are not willing to pay for them. A third factor is that the hinterlands are willing to bid high for innovations, while the municipal enterprises either cannot or are unwilling to do so.

To solve problems of this type we must first bring order to the relationship between reliance and orientation; the solution still lies in reform. In keeping with the spirit of Comrade Deng Xiaoping's speech at the national science and technology work conference, we believe that the enterprises must further increase their conscious reliance on science and technological capabilities in their own geographical areas, departments and units. If the enterprises do not rely on these capabilities, the scientific and technology organizations in question will not orient to them. Second, since the great majority of scientific and technical innovations are commodities, their free circulation should be allowed: we must not simply rely on administrative intervention and uncompensated adoption of innovations. Third, the research units must unwaveringly increase their awareness of the importance of an orientation toward their own geographical area, their own industry, their own department and their own enterprise; they must realize that only by closely linking the interests of the research unit with the interests of its geographical area, industry, department, and enterprise will they be able to develop more effectively themselves. Fourth, the city's research academies and institutes urgently need not only flexibility but also increased capabilities and quality in their orientation toward industry. Some important reasons that many scientific and technical innovations cannot now bear fruit in the city are that they are not at a sufficiently high level, they do not attract the enterprises, or the technology is incomplete so that the enterprises cannot use them.

II. Current Main Tasks of the Reform of the Science and Technology System

Reform of the science and technology system now must focus on three areas.

1. Conscious study of party congress documents, correct evaluation of the status of science and technology system reform in one's own department and unit, and redeployment based on improved understanding.

The main current tasks and objectives in the reform of the science and technology system are the following. Once the independent scientific research organizations subordinate to the city begin comprehensive reform, we must take about half a year to reform the research institutes of the second-level companies in the industrial system and the plant institutes, as well as reforming the agricultural and rural science and technology system. At the same time, we must further improve and intensify the development of technology markets, strengthen the construction of experimental bases in key industries, energetically develop research and production combines, and gradually support certain complete-set technology development centers (or companies) in a focused manner, thus beginning to create the large-scale pattern of science and technology system reform.

2. Take advantage of the favorable moment to accelerate the pace of the reform vigorously and in a safe manner.

a. Reform of independent research organizations subordinate to the city

We have already instituted comprehensive reform in different forms and by stages. But this is just the beginning; a great deal of work remains to be done. First, we must mobilize and organize all scientific and technical personnel to meet this year's research, development, dissemination, and income targets and conscientiously draft next year's plan.

We must strive to find new and effective ways of relating near-term to long-term objectives, central and local tasks, and science and technology to production in the enterprises that are implementing the technology contract system.

In the case of the enterprises that are implementing the economic contracting system and the approach of "two systems in one institute," we must establish project accounting, draft evaluation standards, and establish an internal job responsibility system. We must assure that research tasks that are needed by the state or that produce major social benefits are completed on time. We must take particular care to avoid new "eating out of the same big pot."

b. Reform of second-level companies' research institutes and plant institutes

This work involves primarily the economic committee, which currently is carrying out extensive surveys; it will start by solving the problem for existing second-level companies' scientific research institutes, then solve it for the plant-run institutes. Two steps are involved: by the end of November two activities must be completed. The first is to survey and analyze research institutes of second-level companies and plants in the economic committee's system, give them differentiated guidance and use spot experiments as a basis for announcing reform programs. Second, we must select one or two large or medium-size mainstay enterprises and work out and introduce measures and methods for strengthening the enterprises' technology assimilation and development capabilities.

As regards the reform of the rural science and technology system, surveys and research are currently under way.

3. Intensify surveys and research, devote attention to summarizing experience, and solve new problems arising in the reform process in timely fashion

In order to assure healthy development of science and technology system reform, we must continue to focus on successful solution of the following problems.

a. We must further clarify the objectives of science and technology system reform. We hope that the comrades in all departments that are leading the

reform and the comrades in research units that have begun reform or are preparing to do so will conscientiously relate the current reform to large-scale objectives , because this is the only way to make it produce results.

b. The reform must resolutely adhere to the party line of realistic action.

This comprehensive reform of municipal academies and institutes uses three different forms, each of which is divided into various models and methods. Once the major prerequisites (need for reform, need for orientation, need to break the "large rice pot," establishment of responsibility systems and the like) are made clear, we must respect each unit's creative initiative and not impose a stereotyped approach. In addition, we used to require that the enterprises using the technology contract system eliminate [state subsidy of] operating expenses within 3 years, but it now appears that some units have genuine difficulty in doing so, and therefore we have made it clear that we will encourage enterprises that can do so to achieve economic self-sufficiency as rapidly as possible; most enterprises can finish reducing operating expenses in about 5 years.

c. We must further emphasize that research institutes with a strong industry specificity concentrate on servicing that industry.

d. We must insist that the "two cultures" be equally emphasized.

The reform must be one in which socialist material culture and socialist spiritual culture are advanced simultaneously. It is impossible to build Chinese-style socialism by making an effort only in material culture and emphasizing only economic laws. In the course of the reform we must emphasize party leadership, intensify political and ideological work, strengthen the construction of leadership groups and personnel contingents, emphasize communist ideals and a spirit of devotion to the four modernizations, promote a collectivist spirit and socialist scientific morality, resist bourgeois liberalization, and oppose the incorrect tendency of "thinking of everything in terms of money."

e. We must continue to promote the good tradition that all departments, particularly the integrated departments, financial departments, taxation departments, labor and personnel departments, banks, and the organizational and propaganda departments provide energetic support and cooperation, and we must make a joint effort to develop the current excellent situation in Beijing's reform of the science and technology system.

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NATIONAL DEVELOPMENTS

CHINESE ACADEMY OF SCIENCE LEADING GROUP YOUNGER

Beijing GUANGMING RIBAO in Chinese 2 Sep 85 p 1

[Report: "CAS Leading Group Younger"]

[Text] In recent years, The Chinese Academy of Science [CAS] has combined party rectification with the foundation created by the general adjustment of the branch institutes under CAS two years ago to make further adjustments in the leading group in some of the institutes. The leading groups, after the readjustment, are even younger. Up to the end of the second quarter of 1985, there are more than 500 cadres at the institute level in the 114 branch institutes under CAS. Compared with 1982, the average age of the cadres in leading groups at the institute level is 10 years younger and 83 percent of the cadres have an education level at or above college.

A batch of fine middle-aged or young technical personnel with good ideological style, with experience in technology and with ability to organize and manage their work, has joined the leading group in the institutes. These people are sensitive to new things and very determined to implement the decision from the central government about technology system reform. The majority of the new leading groups are full of vigor and vitality, and work hard. They have penetrated further into the front line, understand the situation and solve problems; they lead the basic units face-to-face, without disputing over trifles, nor shifting responsibility onto others; in work, their speed is faster and has higher efficiency. The majority of the leading groups are united and cooperative with a clear borderline between party and politics; they support one another, thus the problem of "technological research and political work are two different kinds of hide" has been initially solved.

After taking office, the new leading groups in many of the institutes are able to petition to try to find ways and means for systematizing and making more scientific their research work to give an obvious new look in the work of technological research.

At present, CAS is grasping the third stage of construction in order to lay a solid foundation for the new to replace the old in the institutes.

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CAS ESTABLISHES RESEARCH FUNDING SYSTEM

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 25 Aug 85 p 4

[Text] The Chinese Academy of Sciences [CAS] implemented the science funding system for basic research and basic work in applications research in the academies under CAS this year.

This is an important measure adopted by the CAS to carry out the decision of the central authority in the reform of the system of science and technology.

The decision of the CPC Central Committee points out that the science funding system will be tried step by step in basic research and part of applications research and the main purpose is that the research organs doing the above mentioned research should strive for the goal that after a few years the state will appropriate a certain amount of operations fund to be the main allocation for scientific research to cover necessary operating funds and the cost of common facilities.

Sources from the foundation bureau of CAS revealed that CAS has received for appraisal nearly a thousand applications for funds totaling 110 million RMB for research in the academies under CAS. Through appraisal by more than 3,000 experts, 656 research projects are to be subsidized, totaling 34 million RMB.

The subsidized projects include advanced research in weather changes and forecasting, research on the quasi-crystalline structure of alloys, and measurement of microwave radiation of topographic features. Applications from young applicants or from academies in remote areas are given priority for support.

According to the officials from CAS, science funding for 1986 will have some increase and the organization of some of the important comprehensive research must be strengthened.

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NATIONAL DEVELOPMENTS

CAS IN SHANGHAI SETS UP FUND TO ENCOURAGE YOUTH

Beijing REMMIN RIBAO (OVERSEAS EDITION) in Chinese 24 Aug 85 p 4

[Text] The Shanghai branch academy of the CAS has decided to allocate 300,000 RMB from its annual discretionary funds, as youth encouragement funds for the year. It has been learned that at present in the research institutes of the Shanghai Branch Academy, 59 young science and technology personnel and researchers have been granted a certain amount of financial support.

Qing Zhichun [1987 1807 4783], Vice President of the Shanghai Academy, explained to a reporter from JIEFANG RIBAO that the purpose of that decision is to encourage young people to keep forging ahead and to discover and cultivate able young scientists. According to the specific regulations of the fund, the academy will select outstanding research topics with scientific significance and advanced academic thought which are undertaken solely by young people, and provide them with financial support. The Shanghai Academy has engaged 19 scientific experts in related fields to be organized into an expert commission to be responsible for the appraisal and the specific distribution of the fund. Now they have assessed one by one the 66 research topics sent from various academies which are undertaken by young people. Through secret ballot, 59 young people were granted financial support. Among them some got as much as 10,000 RMB and the lowest was still 2,000 RMB. Lu Shifang [7120 0099 5364], a young scientist from the Cell Biology Institute, Shanghai, studies "Separation of nucleus from frog sperm," and the experts thought the nuclei acquired with this method of separation surpassed any of the current methods in purity and completemess, and granted that project 4,000 RMB. Even though the grants are small, the young people still appear happy and satisfied.

The establishment of the Youth Encouragement Fund in Shanghai Branch Academy provides financial support for young scientists who have just started their scientific research, to prevent significant research from coming to a standstill owing to the lack of money, and enables graduate students to do some creative research with their graduate studies.

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NATIONAL DEVELOPMENTS

CAS TO TEST PROFESSIONAL POST APPOINTMENT SYSTEM

Beijing GUANGMING RIBAO in Chinese 2 Sep 85 p 1

[Article by Zheng Haining [6774 3189 1337]: "Lu Jiaxi of CAS on Professional Post Responsibility System"]

[Text] On 31 August President Lu Jiaxi [4151 0857 6932] of the Chinese Academy of Science [CAS], in an interview with our correspondent, stressed that the reform of measures for title assessment and the implementation of the professional work appointment system is an important reform in the personnel system. He said that, approved by the central authorities, CAS will start in mid-July to test the professional posts appointment system using 10 branch institutes as test points; the appointment work in the other institutes will be in full swing after the summarization of experience in the test points; the whole work of the implementation of the professional posts recruiting system in CAS will be finished before the end of June, 1986.

Lu Jiaxi said that the step by step implementation of the professional posts appointment system in science and technology units is an important reform in the personnel system. Establishment of professional posts are based on practical needs; there are specific duties, the number of posts are limited; and within the term, they are paid according to corresponding posts. This kind of system is advantageous to the implementation of the system of personal responsibility, to carrying out the principle of distribution according to work, to fully arouse the enthusiasm of technology personnel, to creation of an environment for competition, to the promotion of reasonable mobility of talented people and for talent showing itself.

Lu told the reporter that the 10 points for testing the appointment system in CAS are, in the area around Beijing, the Physics Institute, Chemistry Institute, Geography Institute, Electrical Engineering Institute, and Microbiology Institute; in the Shanghai area, the Biochemistry Institute, Organic Chemistry Institute, Silicates Institute; in Shenyand, the Metals Research Institute, and in Dalian, the Chemical Physics Institute. The work at the test points will be finished in the middle of May and the recruiting work will be deployed in all of CAS.

Lu pointed out that fine work assessment and good qualification evaluation are the foundation for the decision whether to appoint or not. He stressed

that work assessment must be combined with scientific ethics, ideological moral character, and attitude toward work to be the important basis for appointment. Appointment of professionals must be based on not only need but also qualifications to guarantee the quality. The assessment of professional qualifications mainly includes the three aspects of ability, contributions and level, and contributions must be emphasized.

Lu said that the appointment work of the professionals in CAS will be carried out according to three series, including research professionals, engineering technology professionals and laboratory professionals. Professionals of different levels and classes must be appointed according to the number designated. Advanced research and technology professionals can only be obtained through public recruiting, academic assessment and appointment by the president of CAS. It is estimated that in this year, there will be 600 professionals promoted from assistant researchers to full researchers in CAS, and 3,400 will be promoted from middle rank professionals to advanced professionals. The number of professionals under middle rank will be suggested by the branch institutes and reported to CAS for approval. It is estimated that there will be about 3,000 people promoted from basic rank to middle rank.

Finally Lu stressed that along with the step-by-step implementation of the professional work appointment system, we must pay attention to mobilize and protect the enthusiasm of the professionals in various classes, levels and ages, and make good arrangements for appointing and recruiting work of professionals.

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NATIONAL DEVELOPMENTS

ROLE OF RETURNED STUDENTS DISCUSSED

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 12 Nov 85 p 4

[Article by Xinhua correspondent Zhang Xuequan [1728 1331 0356]: "Paying Back the Homeland After Returning from Study Abroad"]

[Text] In the last 6 years, Shanghai, China's renowned science and education base, has sent more than 4,000 persons to study abroad in more than 40 countries; more than 1,700 of them have already completed their studies and returned. After their return, their first thought has been to place their new knowledge and skills at the service of the homeland. Faced with conditions for experimentation that are inferior to those in some countries abroad, primitive equipment, insufficient materials, and a shortage of funding, they have worked creatively to eliminate difficulties and have created a new situation in scientific work.

Investigating the mechanisms of learning and memory is of great value for developiong human mental capabilities. Fudan University professor Yang Boyi [2799 0130 0308] was the first Chinese academic sent to Stanford University in the United States for advanced training in this field. While abroad he devoted himself to his studies and achieved outstanding results; his adviser recommended him for membership in the American Neurological Society. In September 1981, Yang Boyi completed his studies and returned home, preparing to begin research immediately on brain mechanisms. But Fudan University had no laboratory in this field, and much of the needed instrumentation could not be bought in China. Yang Boyi resolutely canceled his plans to buy an electric refrigerator, a washing machine and a tape recorder abroad, and instead used some of his own savings to buy and bring back instruments such as a micro-electrode probe and technical literature, which he donated to the state without compensation. With the help of the school, he worked unceasingly and rapidly established an advanced laboratory. At the beginning of this year, in cooperation with others in the field, he had already obtained an important result in his research on the brain's memory mechanisms.

One older professor said that if Yang Boyi had had to wait idly for research facilities, this research would have been delayed at least 3 years. This spirit of making every minute count is shown by others as well as Yang Boyi. When Shanghai No 2 Medical University assistant professor Tang Xueming [3282 7185 2494] returned from advanced studies in Canada, he conducted research on

the ultramicroscopic structure of leukemia and stomach cancer cells. He, too, gradually built up his laboratory. As a result of more than 2 years' energetic effort, Tang's results have passed an evaluation and have opened a new approach to investigating the mechanism by which cancer begins.

On their return from study abroad, many persons have been promoted to leadership posts or have become heads of universities, research institutes or laboratories. If political, family, and work responsibilities all weigh upon them, can they still produce earth-shaking achievements? Consider the answer given by Zhuang Songlin [5445 2646 2651], head of the Shanghai Research Institute of Optical Instruments.

In 1979, the 39-year-old Zhuang Songlin went to the University of Pennsylvania as a visiting student to study optical signal processing technology. Working 16 hours a day, during the 2 years 9 months of his stay he completed courses that ordinarily would have taken 5 years; in addition, together with his advisor Yang Zhenhuan [2799 2182 1403], he developed a method for black-and-white coding of color images which solved the difficult problem of long-term storage of color images and was recognized as one of the 6 most important results of optical research in the United States in 1980. Professor Yang wrote a letter to He Dongchang [0149 2639 2490], then Minister of Education, praising Zhuang Songlin as "one of the most important contributors to modern white-light signal processing."

Shortly after Zhuang Songlin returned to the homeland, he became head of the Shanghai Research Institute of Optical Instruments. During the day, he used his time scientifically to deal with his institute duties; at the end of the working day he went home and found some time to take care of family duties; and at 9:00 pm he began to probe the secrets of optics, working until midnight nearly every night. By dint of 2 years of unremitting toil, Zhuang Songlin guided the institute as it completed 6 state scientific research tasks and developed 16 new products. In addition he personally obtained 3 pioneering results and published 7 important papers. His research on partially coherent optical system noise offered a new method of decreasing noise in optical signal processing and received a high evaluation from experts at the 13th International Laser Conference.

At the Shanghai Research Institute of Organic Chemistry, Chinese Academy of Sciences, we visited assistant research fellow Ma Jingji [7456 2417 7535]. In October of last year he returned from studies at Bonn University and was immediately assigned the task of developing a special ion exchange film. Overwork led to recurrent high blood pressure, but he resolutely shut away a pile of sick leave certificates in his drawer, continuing his experiments despite illness. Last April, just as his research work was entering the key stage of synthesis, his daughter was suddenly hospitalized; Ma Jingji entrusted to task of looking after her to a close friend and continued his research. After more than a year he synthesized a special ion exchange film. A patent application was made to the state patent office for this technological innovation this April.

Many of the returned students are like seeds: they are both a mainstay of scientific research and excellent teachers. Shanghai Scientific and Technical University has more than 10 instructors who have studied abroad; in 2 short years they have started 20 new courses for graduate students, written advanced texts, and translated and published more than 10 publications and teaching materials. Guo Benyu [6753 2609 3842], 43 years old, returned to Shanghai from the French Academy, he became deputy head of the school, but continued to involve himself personally in training top-notch talent. On one occasion, the evening before Guo Benyu was to leave for England to give lectures, a graduate student reported on his dissertation outline, but Guo Benyu had no time to discuss it in detail. When he reached England, he wrote a special letter giving his opinions. Since Guo Benyu returned from study abroad, he has been named a Shanghai city model worker for 3 years running.

These returned students are now engaged in prolonged, arduous effort on behalf of the four modernizations and are spending the prime years of their lives in energetic work.

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NATIONAL DEVELOPMENTS

FOCUS ON PATENTS AND PROPRIETARY TECHNOLOGY IMPORTS URGED

Beijing RENMIN RIBAO in Chinese 31 Oct 85 p 5

[Article by Wang Zhaoxiong [3769 0340 3574]: "Focus on Importing Patents and Proprietary Technologies"]

[Text] As science and technology unceasingly advance, technology trade between all countries of the world is continually expanding; the international technology trade volume now amounts to several tens of billions of U.S. dollars a year. Licensing of patents and proprietary processes between the industrially developed countries has always accounted for an important proportion of this business. In technology import, China has always overstressed complete sets of equipment and production lines, and there have been problems of unnecessary duplication of imports and overimportation. In addition, the provisions of some licensing agreements are not sufficiently thorough, the prices are not reasonable, and in some cases losses or swindles have occurred. The CPC Central Committee Resolution on Reform of the Science and Technology System clearly states that in the future China must accord the importation of technology an important place when developing production technologies and renovating existing enterprises and must focus on the importation of patents, technological secrets and software.

We offer the following suggestions for effective importation of patented technologies and proprietary technologies.

1. Effective Dissemination of Information on Industrial Ownership Rights

"Industrial ownership rights" are the rights of ownership of technological inventions used in industry and of production markings, e.g. patents, trade marks, and the like. China has formally joined the Paris Convention on Protecting Industrial Rights of Ownership, and accordingly in technology importation we must observe our international duty to protect them. Personnel on the science-technology and economics and trade fronts must have thorough information on industrial ownership rights; they must be clearly aware of what constitutes industrial ownership rights and knowledge, ownership rights, what should be protected and how, and what should not and need not be protected, as well as understanding the objectives of this protection.

2. Effective Cooperation in Relevant Areas and Intensified Overall Management

In the future, technology import must truly involve importation of the best for our use. It is very difficult to select technologies for import. For example, in order to make correct decisions about the signing of patent licensing agreements, a literature search must be made to obtain technical and economic information about similar patents held by different companies (or firms), the firms' backgrounds must be investigated, technologies must be analyzed to see whether the products are in accordance with the patents specifications, and so on. We must organize organic cooperation between the foreign economics, patents, scientific and technical management, information, and research and development departments, make feasibility analyses of the up-to-dateness, suitability, reliability, effectiveness, economic rationality, and investment feasibility of the selected items before beginning commercial talks, and overcome blind decision making in order to choose the correct policy and import technologies that are reasonably priced, technically advanced, in keeping with the national situation, easy to assimilate, and capable of promoting domestic self-sufficient research and development.

3. Place Technology Import on a Scientific and Legal Basis

Licensing trade is still a relatively new activity in China, and there is a great need to emphasize licensing agreements that are more scientific, particularly the effective drafting of important clauses that differ from those in commodity trade, such as guarantees, authorizations, technology protection, secrecy, transfer of risk, damage claims, and clauses involving third party infringement, and effectively written technical content. Patent law affects only advanced technology for which a copyright application has been made in China; imported proprietary technologies are now protected chiefly by contract. In licensing trade we must establish and maintain effective legal, management, consulting services, and information systems. The relevant departments must strengthen their overall guidance of licensing agreements and organize economic exchange in timely fashion.

4. Establish and Maintain an Effectiving Licensing Business Contingent That Has a Knowledge of Both Our Own Circumstances and Those of the Other Party and is Rational and Principled in Discussions and Enterprising in Its Work.

In the technology import process there are many problems of current importance that require study, such as shares in technology in Chinese-foreign joint capital enterprises, and invention and creativity ownership rights in Chinese-foreign cooperative development and cooperative research. In addition, in the licensing trade there are also such problems as technology export and the like which must be investigated.

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NATIONAL DEVELOPMENTS

ANHUI SCIENTIFIC CONSULTING ACTIVITIES

Hefei ANHUI RIBAO in Chinese 10 Aug 85 p 1

[Text] Sources from the recent provincial science and technology consulting conference revealed that under the care and support of the provincial party committee and the provincial government in the past year our province has acquired obvious economic and social results in the work of science and technology consulting work for 200 enterprises, finished 396 consultations and created an economic value of more than 130 million RMB [Renminbi] with an increase in tax revenue of 30 million RMB. And through consulting activities, the science and technology consulting business has been promoted and developed quickly.

In order to implement the policy, "economic construction must rely on science and technology and science and technology must be oriented toward economic construction," our provincial science association started science and technology consulting service early. Owing to a weak industrial foundation, lack of able people, and backwardness in technology in our province, the provincial science association issued a slogan of "two orientations," that is, oriented toward medium and small enterprises and toward rural enterprises, and "three services", that is, to promote economic results, turn loss into profit and increase vitality for enterprise. The leading cadre of the provincial party committee approved that method. The activities of their service are mainly to promote the following:

1. To meet the urgent need for production and organize technological forces to serve some enterprises to promote their economic results. 2. To combine the good qualities of others to develop new products to save enterprises facing bankruptcy. 3. To meet the workers' demands and equip rural enterprises with technology. 4. To combine intelligence to serve the leaders in various levels in their decisions. The New Technology Research Association in Maanshan, in its "systems consulting on the newly built Jiangnan sheet iron plant," in order to take advantage of the superiority of local resources, suggested changing to produce wire products. The association provided consulting services on the production process and succeeded with a trial run within 86 days and earned a profit of 1,080,000 RMB that year. The Chu County district science and technology consulting center offered service to Chu Zhou TV plant and introduced foreign capital to double the profit of that plant in that year and that enterprise was named an advanced enterprise.

In the conference, 11 advanced units were cited and awards were given to 35 outstanding consulting projects. Vice governor Yang Jike [2799 4764 3784] was present and addressed the conference.

12909/12790
CSO: 4008/2031

REPORT ON REFORM ON SHANXI S&T SYSTEM

Taiyuan SHANXI RIBAO in Chinese 12 Sep 85 p 2

[Report by Wu Dacai [0702 6671 2088], chairman of the Shanxi provincial Science and Technology Commission to the 14th session of the provincial NPC Standing Committee, 6 Sep 85]

[Text] The Development and Current Situation in the Reform of the Science and Technology System in our Province

Since the 3d Plenum of the 11th CPC Central Committee, our province, pushed by the wave of the rural economic system reform in the process of carrying out policies in the development of science and technology, has gradually made some local reforms in the system of science and technology. The reform is centered in two aspects: one is the advantage of science and technology in serving economic construction; the second is to encourage the enthusiasm of scientific and technical units and personnel. Looking back at the process of reform in the Science and technology system in our province, it can be divided into three stages:

In the first stage the focal point was the rural areas. In 1979 and 1980, we summarized the experience of organizing agricultural technology in the rural areas in the counties of Wenxi and Yangcheng and popularized the contract method of technology. In 1981, acting in the spirit of "Outline of Report on the Policy for Development of Science and Technology" issued by the State Science and Technology Commission party group, and adhering to the orientation that science and technology must serve economic construction, we continued to explore the reform of rural and urban science and technology work to serve economic construction. In this stage, the essence of the various work is centered around exploring the possibility of how science and technology can serve economic construction.

The second stage started in 1982. The project contract system first started that year among the units of science and technology and the reforms establishing the economic responsibility system were implemented, and then the integration of responsibility, power and profit was put forward to implement the system of the president being in charge of the institute, and the authority of project leaders was extended; in distribution of labor, the principle of paying by work was embodied. At the same time, we found and summarized in timely fashion some advanced model institutes which did not rely on the state for capital and put their roots in the demands of economic

construction, and relied on their own strength to operate and build up the institutes. Between July and August 1983, the provincial science and technology commission organized to investigate the reform of the rural science and technology system in southeastern and central Shanxi and summarized their experience on organizing professional agricultural personnel and peasant technicians to establish agricultural technology service centers, stations and various kinds of service companies in county and commune levels.

Since 1984, there have been new developments in the reform of the system of science and technology in our province. The provincial people's government called a provincial work conference of science, technology and intellectuals to summarize the experience and problems on the system reform of science and technology in the past few years, and formulated "Temporary measures to solve the problems in science and technology reform in Shanxi." The provincial science and technology commission decided to use the eight units, Provincial Chemical Engineering Institute, Mechanical Engineering Institute, Architecture Science Institute, Electronics Institute, Institute of Pomology, Changzhi Light Industry Institute, Jiaocheng Institute of Forestry, and Datong southern suburban Institute of Vegetables, as the first batch of test points for the paid contract system reform; later 10 units such as the provincial Institute of Husbandry, the Institute of Synthetic Fibre and Taiyuan Municipal Architecture Material Institute were added as test points for departments, bureau and city levels. Various types of private science and technology research units in the province, technology development centers, and technology service companies were active in various battlefronts, and kept close contact with the demands of the society, to tackle various technological problems, offer technical consultation and service, training, technology transfer and exchange of technical personnel, and played a positive role to promote development of technology and production, exchange of talented people and opening up new markets.

The technology market in our province first came into being along with the implementation of a series of economic reforms in science and technology research units and the establishment and development of private science research and technology service units, and people started to realize the importance of technology merchandizing and of opening up technology markets in the reform of the system of science and technology. Since last year, the activities of departments in various levels in opening up technology markets and promoting the transfer of technological results toward production have been gradually changing from spontaneous ones into conscious ones.

In a word, the characteristic of this stage is that the reform of the science and technology system, along with deeper development in the economic system reform, is also gradually developing in depth to create conditions for an overall reform which will finish the preparation work.

The third stage started with the National Science and Technology Working Conference in 1985. Under the guidance of the spirit of "Decision of the CPC Central Committee on the reform of the science and technology system," the provincial party committee and the provincial government have studied many times and formulated an overall enforcement program on the reform of the

science and technology system in our province and made it known to the lower levels in July. Under the guidance and attention of the leaders of the governments and departments in various levels, the overall situation on the reform of the science and technology system is very good and continuously advances and develops. Some technology research units in our province are consciously orienting towards the economy and society and exploring ways to realize economic self-sufficiency. There have been more than 10 fairs of technological products in 10 prefectures and counties in our province this year, including the provincial fair of technological products and the attendance of our province in the first national fair of technological products where 638 items were sold totaling 60,925,000 RMB. There were new development in the integration of science research, teaching, design and production.

Principal Content of the Provincial Science and Technology System Reform Enforcement Project and Suggestions for the Next Step of Enforcement

The overall guiding thought of the Resolution of the CPC Central Committee on the Reform of Science and Technology Systems" is that "economic construction must rely on science and technology and science and technology work must be directed toward economic construction." The purpose of science and technology system reform is to overcome the serious drawback of dislocation of science and technology from production, and establish a new scientific operating system for science and technology management. Based on this kind of guiding thought and purpose of reform, we formulated the overall enforcement project on the reform of science and technology systems in our province, and offered some specific requirements and measures. The principal content can be summarized in the following aspects: The problem of reform of science and technology allocation system is the focal point of the enforcement project. From now on, we must rely on opening up science and technology markets and change the practice of everything relying on the state; and practice classified fund management according to the characteristics of different types of science and technology activities. According to the real situation in our province, the reform of the overall fund management system is like this: the investment in science and technology in provincial, district and county levels must be gradually increased at a speed higher than the increase of regular financial income. The three items of expense on science and technology and science operating expenses in the province must in general be controlled in three major categories, that is, contracts for technology, the fixed fund system for operating expenses and the funding system for scientific research.

In the opening up of technology markets we emphasize the opening up of technology markets in the broad sense; the importance does not lie in formalism but in the establishment of some kind of market system favorable to a closer tie between technology and production through various kinds of forms in order to dredge the channels of technology exchange, and favorable to the circulation of demand and supply of technology. And at the same time, we emphasize that all departments related to technology management should pay attention to strengthen the guidance of technology markets to combine the real situation of the district and the department to formulate reasonable policies to guide technology transfer in great quantities toward the right

direction. We must in a macroscopic point of view, put technology research projects, technology innovation programs and product development projects into the realm of the technology market and put them into the hands of technology committees at various levels for coordination, arrangement and consideration as a whole. At present, we must pay great attention to technology developments and absorption which are insignificant in appearance. In the establishment of technology exchange mechanism, governments in various levels must provide necessary help in capital, personnel, material and conditions.

In increasing the ability of technology absorption and development of the enterprises, stipulations of the state and of the province must be carried out seriously and should proceed with the reality of individual units both with emphasis on the promotion of the backbone function of the technological personnel and workers available, on organizing their own technology development force, extensively promoting technology innovation activities of a mass character, and, with encouraging various enterprises and technology development or research mechanisms to unite in a voluntary and mutually beneficial manner, promote technology development and accelerate the transfer of results.

In the reform of the agricultural system, it mainly points out that the reform of the agricultural system must first fit the agricultural economic reforms, fit the need for the development of agricultural economy toward specialization, merchandizing and modernization, to promote and serve the overall development and integration of management of agriculture.

At present, there exist two main problems in technology system reform: one is the lack of an effective organ for implementation and the slackness of putting the measures into effect; the other is the lack of profound and detailed investigation and study, and the inability to have the detailed situation well in hand. These are mainly manifested in the lack of arrangements on how to further implement the enforcement plan in the province and in many aspects detailed regulations for the implementation of the reform could not be presented; and the work of formulating technology regulations fell short of reality.

Based on the requirements of the above implementation plan and the problems which exist and in the next step of organization and implementation, we should stress the following aspects in the work:

1. Combine the guiding ideology of party rectification, and correcting work to meet the demands of technology reform in order to free technology reform from the small coterie formed over a long period of time which grasps items only and free it from the small coterie with the habitual tendency to grasp routine work, to change the stress in technology management to the study of strategy for technology development, to the formulation of technology development principles, policies, regulations and technology legislation, in order to strengthen macroscopic guidance in technology work in the province, to do a good job in the overall work in the province and to make the most of science and technology in the promotion of economic development.

2. Macroscopic management requires having the overall situation in hand and understanding the overall situation. We should strengthen the investigation and understanding of the work in the technology committees in the prefectures and counties and the work of technology system reform in the major institutes and branch institutes and the combinations of technology research, teaching, design and production; we should strengthen investigations about the current situation, models and experience of ability to absorb and develop technology among the enterprises.

3. Strengthen technology legislation and regulation work.

At present, in the work of technology legislation, the following aspects should be strengthened:

a. Measures for Shanxi provincial natural science and technology funding management;

b. Measures for Shanxi provincial science and technology development funding management;

c. Provisional regulations for the implementation of technology contracts in science research and development organizations;

d. Provisional regulations for the implementation of cash and in kind payment for operating expenses in science research organizations;

e. Control measures for private science research organizations;

f. Provisional measures for opening and control of technology markets.

4. Organize the administration of reform measures. At present, first the provincial independent technology research units should follow the requirements of the technology allocation system to implement classified control.

5. The provincial technology exchange center is one of the new type technology exchange organizations created to meet the needs of the technology system reform; its important task is to dredge, through different means and ways, the channel from science and technology to economic construction. Therefore, it is also important in running well the provincial science and technology center and it should be considered as a test point for technology system reform; emphasis should be given to it with necessary support of manpower, money and materials.

6. Starting in the next half of the year, we must grasp a batch of "short-term" technology promotion items with great significance in vitalizing the economy of our province. In the choice of these items, they should be able to give full play to the superiority of resources in our province, to exploit and utilize the abundant coal and to develop the three major materials. And agricultural sideline product processing should be developed with great efforts, such as improving coke ovens, developing molded coal, and apple

preservation. The time period of merchandizing of technological results for these items is short and fits the technological levels of the medium and small enterprises, and it takes less time to gain economically beneficial results. If we can do well in these items, it will have a direct effect on promoting the technology levels among the medium, small and rural enterprises and promoting the local economy.

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NATIONAL DEVELOPMENT

IMPORTANCE OF INDEPENDENT RESEARCH ORGANIZATIONS DISCUSSED

Beijing KEXUEXUE YU JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF S&T] in Chinese No 8, 12 Aug 85 p 1

[Article by Wang Kejian [3679 0344 0313]: "Independent Scientific Research Is a Research Capability That Must Not Be Neglected"]

[Text] As a supplement to scientific research units run by the whole people, independent scientific research units, which are small in size, flexible in their operations, subject to few constraints and highly efficient, have already become the sixth major force in China's scientific research ranks and constitute a separate movement, of demonstrated vitality, in the reform of the science and technology system. They have had a positive effect in stimulating technology markets, promoting the development of enterprises in the countryside, developing emerging technologies and making use of the untapped capabilities of scientific and technical personnel. The CPC Central Committee Resolution on the Reform of the Science and Technology System clearly states: "Groups or individuals are permitted to establish scientific research or technical services bodies."

Independent scientific research organizations are a product of the time which have arisen in response to the social need for China's 1.5 million rural enterprises to develop new products. They are a new type of scientific organization, created by scientific and technical personnel who were constrained by the existing system and wished to make use of their talents and knowledge, and they are a product that has emerged from the reform of the science and technology system. They have broken out of the uniformity of the scientific research system under the ownership of the whole people and out of the rigid mold in which scientific research organizations long had to "eat from the big rice pot." They use flexible management that is compact and capable, and they are a form of scientific research organization that inevitably arises and persists in a society where diverse economic forms coexist. Like other collective economic organizations, they are a form that supplements the socialist system of ownership by the whole people and they have a legal standing throughout the socialist period. Independent scientific research may well make a prominent contribution to the development of China's science and technology.

The development of these scientific research organizations will give the organizations under ownership by the whole people competition in terms of

scientific research results, personnel, and research effectiveness. We must recognize that this competition is a good thing. Only the existence of competition stimulates the competitors' resourcefulness, for example by gradually decreasing such abnormal phenomena as an oversupply of qualified personnel and the stifling of talent. Thus it is a competition that promotes socialist prosperity and development and the linking of science and technology to the economy and society. This competition will bring about a new flourishing of scientific research.

By the freshness of their guiding ideas, their operating approaches and their attitude toward using their personnel, the independent scientific research organizations have opened up a new channel of scientific research. Like any new shoots, they need to rely on their own powers to develop and grow vigorous, but they also need protection and support. Independent scientific research organizations currently face such difficulties as the absence of a unified tax policy, of a designated line of subordination for their party organizations, and of an organization to review and approve foreign technology exchange, and there is an urgent need to establish appropriate management rules and regulations. In response to these problems, in the spirit of the CPC Central Committee resolution on Reform of the Science and Technology System, which states that "the local governments must manage them and give them guidance and assistance," Shanghai, Anhui and Hunan have drafted applicable provisional regulations. Although still, imperfect, these regulations do represent an advance. We are confident that other provinces and municipalities will also make a contribution to this aspect of the reform of the science and technology system by smoothing the road for healthy development of independent scientific research.

China has more than 2 million enterprises, most of which are backward in terms of technology and equipment and must be renovated with new technology. It will be quite inadequate to rely solely on the limited number of research institutes under ownership of the whole people to achieve this objective; the independent scientific research organizations, with their advantages of compactness, organizational simplicity and quick responsiveness, will have immense scope for the exercise of their abilities in the vast expanse of China. They will be able to utilize their advantages of extensive sources of information, choice of their own topics, flexible organization and an emphasis on efficiency to perform research services that are fully integrated all the way from selection of topics to production at designated locations, and thus to solve the enterprises' problems in technical modernization and renovation.

Naturally, as the reform of the science and technology system deepens, under the impetus of the technology contracting system and the technology marketplace, the research institutes under ownership of the whole people that focus on the application and development of technology will also become increasingly flexible and the independent research organizations will face new competition and new challenges. But we are confident that the independent research organizations are a good form of organization for scientific research and that the scientific and technical personnel who dared to break out of the old scientific research system and who braved adversity to stand on their own feet will be able both to develop a new scientific research system and to make even greater strides in developing the emerging technologies.

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OFFICIAL DESCRIBES DRAFTING OF SCIENCE, TECHNOLOGY RESOLUTION

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENTIOLOGY AND MANAGEMENT OF S&T] in Chinese No 8, 12 Aug 85 pp 6-7

[Article by special correspondent Xu Minzi [1776 2404 1311]: "A Magnificent Blueprint: State Science and Technology Commission Vice Chairman Wu Mingyu Discusses the Resolution"]

[Text] For China's science and technology circles, the CPC Central Committee Resolution on Reform of the Science and Technology System is of epoch-making importance. While scientific personnel both in and outside China were warmly welcoming this key document which "marks a second springtime for science," I was on Beijing's spacious Chang'an Street reflecting on it and wishing earnestly to know something beyond the document itself. This wish prompted me to visit the State Science and Technology Commission in Sanlihe, where I had an enthusiastic conversation with commission Vice Chairman Wu Mingyu [0702 2494 3842].

The Resolution: A Result of Scientific Policymaking

I came straight to the point with my first question: "Can you discuss the Central Committee's policymaking process with regard to the resolution?"

Wu Mingyu immediately revealed the essence of the matter: "The resolution was the result of scientific policymaking."

Wu stated that the resolution was a major macro-scale policy decision which for the first time elevated the importance of reforming the science and technology system to all-important strategic status. In terms of large-scale social cycles, science and technology are decisive factors in modern economic development without which economic takeoff is impossible. But certain abuses that existed in China's science and technology system for some time had hindered the utilization of scientific and technological capabilities so that they were quite unable to meet the requirements of economic construction and development. The drafting of the resolution laid down the general plan for reforming the science and technology system and laid an excellent foundation for establishing a new science and technology system oriented toward the economy and towards society.

The resolution was produced under the direct guidance of such Central Committee leaders as Hu Yaobang and Zhao Ziyang. It is a crystallization of collective

wisdom which has a realistic practical basis and a solid mass basis. Wu Mingyu told me that when the resolution was being drafted, 16 survey groups made up from more than 20 ministries and commissions had investigated several hundred scientific research and management units in 14 provinces and municipalities and had summarized the experience of spot experiments with system reform in more than 600 independent research organizations in the last 2 or 3 years, and that more than 300 specialists, experts and leading cadres from China's science and technology sphere and enterprises had taken part in the drafting, in addition to which 25 scientists in the United States had been invited to visit China to participate in conferences. The Education, Science, Culture and Public Health Committee of the Standing Committee of the National People's Congress, the CPPCC, the Central Committee of the Democratic League and the Central Committee of the Jiu San Society took part in the discussions, and several dozen ministries and commissions under the CPC Central Committee and the State Council made serious suggestions for revisions. The draft of the resolution was also submitted to 490 members of various academic committees throughout the country for suggestions. The process of drafting the resolution was in accord with the scientific principles of systems engineering, since it was considered in rather comprehensive terms from the very beginning, avoiding a roundabout process. The party Central Commiteee took extreme care with the final decisionmaking, repeatedly weighing advantages and disadvantages, thoroughly evaluating various problems that could arise and taking the necessary steps to limit adverse factors.

Two Major Breakthroughs in the Resolution

"What are the major breakthroughs in the resolution?" was my second question.

Wu Mingyu said that in regard to the current reform of the science and technology system, the resolution focused on three links: the operating mechanism, organizational structure, and the personnel system. The resolution's proposals to reform the wage system and to develop the technology marketplace were concerned with correcting the past reliance on purely administrative measures in directing and scheduling scientific and technical work, so as to assure that the science and technology system will have a self-developing operating mechanism that automatically serves economic construction. The breakthrough and reform in these two areas will enable our work in science and technology to adapt to the socialist commodity economy, to make thorough use of economic levers and the market mechanism to promote the advance of science and technology, and to accelerate the application of scientific and technical results in production, which is also a major conceptual change. Experience has shown that the traditional method of exclusive reliance on administrative measures, with the state monopolizing research funds, not only is incapable of making science and technology develop rapidly, but actually limits the vitality of the research machinery and hinders scientific and technical development. Since 1983 more than 600 independent research organizations that were given free rein and have reached the point of not receiving operating expenses from the state have become filled with vitality: their efficiency has been vastly increased, their research progress has been greatly accelerated, their

number of results has been increased severalfold, and their research earnings and the benefits to their personnel are much better than under the old supply system; the intellectuals' knowledge and capabilities have been quickly perceived by the workers and cadres, slackers have become industrious, time-servers have ceased to be time-servers, and the research institutes present a flourishing overall picture. Naturally, the reform of the research system is differentiated for scientific research of different types and at different levels. But in general terms, the reform of the wage system and the opening up of technology markets will gradually get our scientific development onto a path that is in accord with the laws of scientific and technological development and the laws of economic development.

Profound Consequences of the Reform Both at Home and Abroad

I asked Wu Mingyu what the response had been in scientific and technical circles at home and abroad when the resolution was published. He told me with pleasure that it had evoked an intense reaction. Domestic scientific-technical and academic circles believe that the resolution is a key document that will provide encouragement and is in accordance with China's circumstances, and that it marks the arrival of a second springtime in Chinese science. It raises the influence and role of science to new heights and has resolved some long-standing problems of the science and technology system in macro-scale terms and in terms of theory and policy. The implementation of the resolution will give scientific and technical personnel increased scope for the exercise of their abilities, unfettering their potential so that they can make a bigger and better contribution to China's socialist modernization. Twenty-five overseas Chinese scientists living in the United States and working in United States university, industry and federal government research organizations returned to China by invitation to take part in the discussion. They included such senior specialists and experts as Yang Zhenning [2799 2182 1337], Li Yaozi [2621 5069 3320], Xin Kenan [2450 0668 0589] and Zuo Tianjue [1563 1131 6030] and such younger specialists as Nie Huatong [5119 5478 2717], Qian Zhirong [6929 5268 2827], Xian Kongfeng [2009 1313 6912] and Pan Yugang [3382 3022 0474], all of whom have frequently returned to China and are familiar with domestic conditions. When invited to return to China and participate in the discussions on the reform of the science and technology system they were greatly moved, stating that the summons from the Homeland to take part in such important discussions at the historic moment when the Homeland was making important reforms was indeed the most gratifying event and the greatest honor of their lives. Some of them even laid their letters of invitation away as treasured mementoes. Famous scientist Yang Zhenning said that it was unprecedented for specialists from abroad to be invited to discuss important CPC Central Committee policy questions and that this expressed immense concern on the part of the CPC and marked the attainment of new heights by China's open door policy. Famous scientist Li Zhengdao [2621 2398 6670] was unable to come to Beijing, but when he received the draft of the resolution from Premier Zhao's messenger in the United States he was moved to submit his opinions in writing.

Overseas scientists living in the United States affirmed that the spirit and orientation of this reform of the science and technology system are

correct and in accordance with China's current real situation and actual requirements; they were in full agreement with the emphasis on turning technological results into commodities and developing technology markets, and they concluded that only by developing such markets and promoting technology transfer would it be possible to convert science and technology into productive forces, which is a problem that urgently requires solution in China. The direction of reform specified in the resolution is not only necessary but practicable, they felt.

"The resolution lays out a blueprint for science and technology in China and stimulates China's science and technology to orient themselves better toward the economy, which will have a far-reaching influence on China's scientific and technical development and economic construction," said Wu Mingyu as we parted; this was stated as a kind of summation, but also with emphasis.

On my way home I thought of a poetic passage written by Gorkiy: "Science gives wings to our thought, enabling us to soar amidst the mysterious kingdom of the universe, to fathom the unknown and to solve the tragic riddles of life. Science opens for the world the road to unity, freedom and beauty." I reflected that the drafting and implementation of the resolution cannot fail to make China's billion people hasten along this road more rapidly and arrive sooner at the realm of unity, freedom and beauty.

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NATIONAL DEVELOPMENTS

BRIEFS

CAS ESTABLISHES YOUTH SCIENCE FUND--The Chinese Academy of Sciences recently decided to establish a youth science fund this year to support scientific research by science and technology personnel under 35 years of age who have creativity and exploring ability. The youth science fund will be allocated from the Academy's Presidential fund and was listed as 2,500,000 RMB this year to be shared by 60 scientific research projects. The purpose of the youth science fund is to break the tradition of appropriation according to seniority, to provide room for young outstanding scientists to use their talent, and to discover among them leaders in the academic field to contribute to the state in the development of the economy and the progress of science and technology. CAS asks its branch academies and institutes to start to do this work now. The procedure for application is: the applicant must himself apply: all science research personnel, even new university graduates, are eligible to apply. The applications will be recommended to the CAS and then turned over to related experts for appraisal. The final decision will be made by conference of the presidents of the academies. [Text] [Beijing GUANGMING RIBAO in Chinese 21 Aug 85 p 2] 12909/12790

CSO: 4008/2031

APPLIED SCIENCES

NATION'S LARGEST CONTROLLED FUSION RESEARCH FACILITY

Hangzhou ZHEJIANG RIBAO in Chinese 21 Nov 85 p 1

[Text] Following a debugging process in the year since its smooth start-up in September 1984, the "China HL-1," the nation's largest controlled fusion experimental facility; has achieved its first major experimental results. Today, it was formally certified by the state at the Southwest Physics Institute of the Ministry of Nuclear Industry in the outskirts of Leshan City in Sichuan Province.

After a year of experimental operation, the "China HK-1" has already a steady discharge at an equilibrium of 135,000 amperes in a 23,000-Gauss magnetic field. Peak current is reached in two-tenths of a second. The sustained stability of the plasma generated by the unit lasts for a second, far beyond the original design requirements. The unit is not only in first place domestically, it is also exceptional among comparable experimental units anywhere in the world. It provides difficult-to-obtain plasma material for China's controlled fusion research.

Experts claim that these achievements demonstrate that the design of "China HL-1" is advanced and that quality is excellent. It has set the stage for the nation's controlled fusion research to enter a new phase of experimental research with larger facilities and enable us to join the ranks of those countries with units of medium size and larger to promote this research. It is a major advance for science and technology in the period of the "Sixth 5-Year Plan." Controlled fusion is an important task for science and technology today. It takes the nuclei of the atoms of such light elements as deuterium and tritium, and, under super-high temperatures, creates a fusion reaction to release an enormous amount of energy. Calculations show that one liter of seawater contains 3 milligrams of deuterium and its fusion yield is comparable to 300 liters of gasoline. As a result, as soon as controlled fusion goes from the experimental stage to the stage of practical application, the vast oceans will become an ideal and inexhaustible energy reservoir. "China HL-1" is an experimental facility undertaking this research.

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APPLIED SCIENCES

POWER CALIBRATION, HOT POINT MONITORING OF HFETR

Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 6 No 4, Aug 85 pp 37-42, 27

[Article by Xu Jiangqing [1776 3068 3237] and Li Zehua [2621 3419 5478]]

[Text] I. Determination of Reactor Operating Power

The operating power of an HFETR is determined by the requirement of the experiment. The operating power of each furnace can fluctuate within the limits of the maximum design power (125 MW).[1]

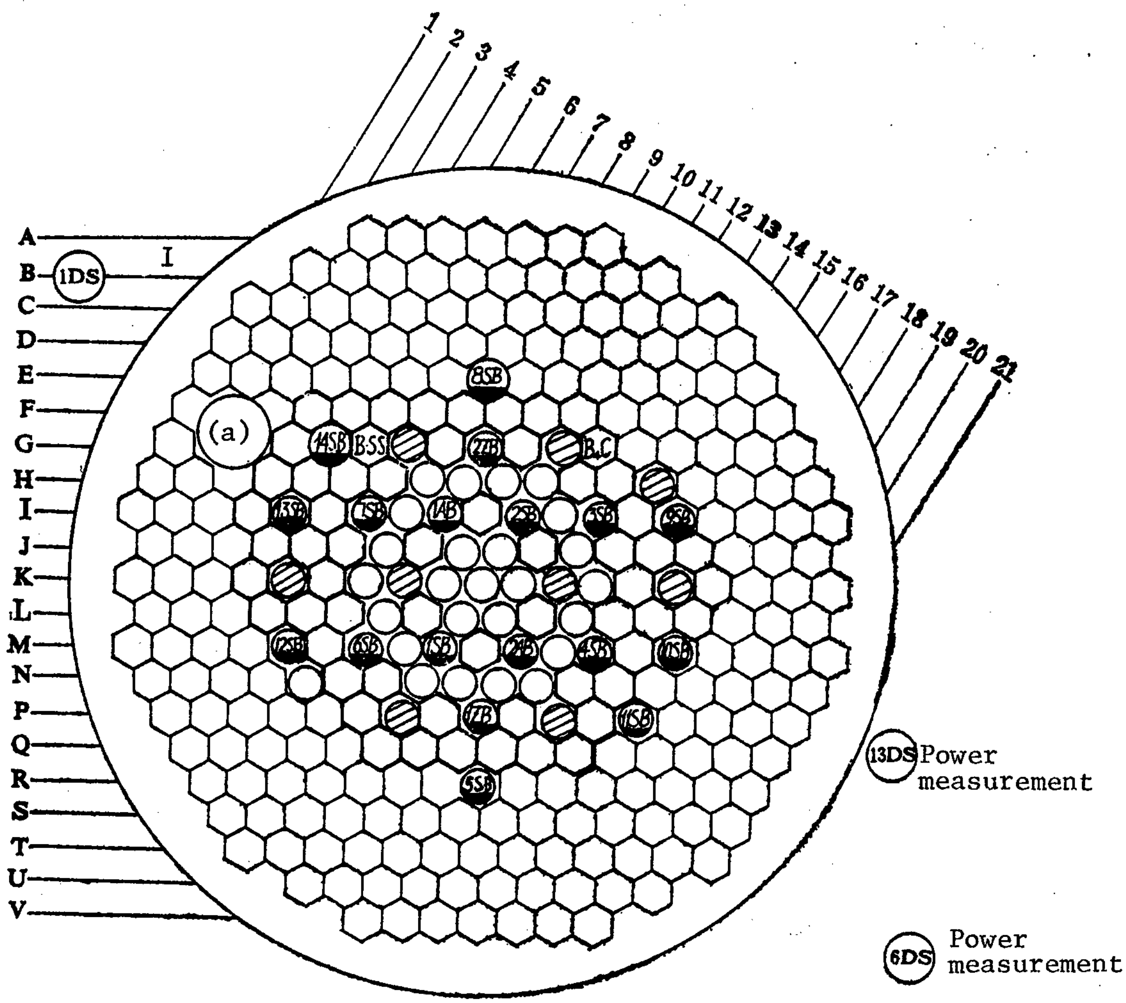
The loading of the No 1 furnace (Figure 1) is primarily designed to test the performance of the reactor, specifically the performance of the multilayer casing fuel elements. Therefore, during the entire period of operation, the elements should be kept below the level of maximum design surface heat flux q^{max} (3.06×10^6 kcal/m^2·h). Based on this requirement, the operating power should reach a maximum value given by the following expression:

$$P = \frac{1}{866 \cdot \varepsilon_1} \cdot \frac{q^{max} \cdot F \cdot N}{K} \quad (\mathrm{kW}) \tag{1}$$

where F = 1.395 m^2 is the total heat dissipation area of one box of elements; N is the number of boxes in the reactor; $K = K_r + K_z + K_o$ is the overall coefficient of power nonuniformity of the reactor, which is the product of the radial, axial, and grid element coefficients of nonuniformity K_r, K_z, K_o; ε_1 is the amount of heat generated by the element plate as a fraction of the total fission heat, for HFETR, $\varepsilon_1 = 0.9$.

During reactor operation, the coefficient of power nonuniformity is constantly changing; consequently the operating power limit also changes, as indicated by equation (1). Changing the operating power frequently poses difficulty for the operator. In the No 1 furnace of the HFETR, a stagewise varying-power operation is used so that the hot-point element is at or near its state of maximum level of heat generation during the entire period of operation.

During the operation of the No 1 furnace, the burnup reactive loss is primarily compensated by the No 1 and No 2 compensation rods (1SB, 2SB), and the hot point of the reactor is located on the surrounding elements. Therefore, one



control rods, 18 pieces
elements, 25 boxes
targets, 10 pieces
aluminum blocks, 196 pieces
beryllium blocks, 50 pieces

Figure 1. Loading Diagram of No 1 Furnace

Key:
a. Single crystal silicon

can use a combined approach of theoretical calculations and zero-power test results to determine the variation of the coefficient of power nonuniformity as a function of the lift height of the 1SB and 2SB rods (Figure 2). By using equation (1) and Figure 2, one can also plot the curve of the operating power limit versus the lift height of each of these two rods (Figure 3). As the reactor operation proceeds, the 1SB and 2SB rods are gradually lifted from the reactor core; based on the lift height readings, the power level of the

reactor can be determined. We divide the period of operation into several stages and specify the power limit for each stage). By using stagewise varying power operation, the fuel elements can be maintained close to the state of maximum heat generation during the entire operation. This is important for completing the test of the reactor elements.

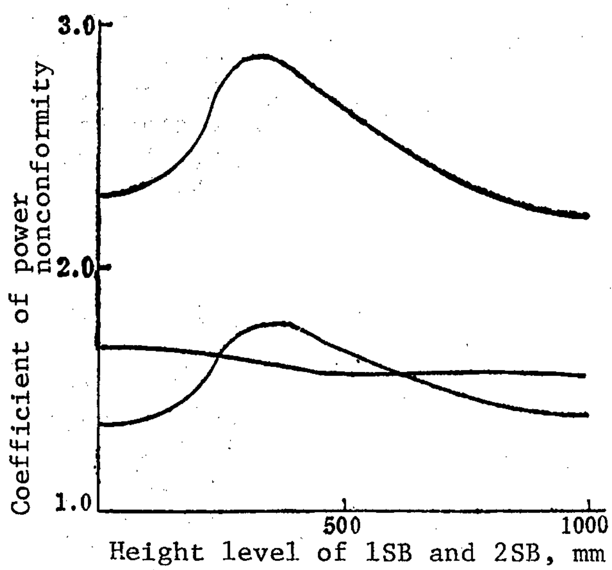


Figure 2. Coefficient of Power Nonuniformity at Different Height Levels of No 1 and No 2 Control Rods

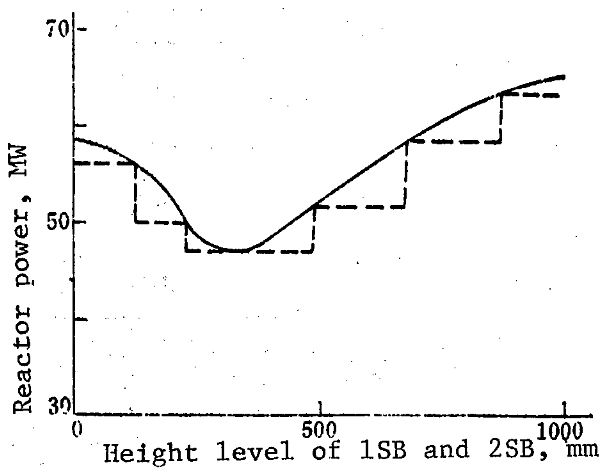


Figure 3. Limiting Values of Operating Power at Different Height Levels of No 1 and No 2 Control Rods

II. Power Calibration

Two different methods were used to measure the absolute power of the HFETR: the physical method and the thermal method.

1. Physical Method

The physical method uses different probes to measure the relative distribution of neutron flux in the active region and the absolute value of neutron flux at a particular point, then uses the calculated reactor power to calibrate the power measuring instrument. This method is generally used under low-power conditions, but with appropriate corrections, the calibrated results can be extrapolated to high-power conditions, and used as guidelines for conducting power enhancement experiments.

During the power calibration experiment conducted in the No 1 furnace of the HFETR, the following methods were used for measuring the absolute value of neutron flux: the gold-plate activation method, the self-energizing probe method, the pneumatic ball method, the solid track method, and the noise analysis method. In this article, only results from the more mature gold-plate activation method are presented. In particular, this method was used to measure the absolute neutron flux 300 mm above the center of the L_{12} element (Figure 1) at three different power levels and the relative power distribution of the entire active region (Table 1).[2,3]

Table 1. Results of Physical Calibration of Power Meters

Sequence number	1	2	3
Power meter reading, *A	0.22×10^{-7}	0.22×10^{-6}	0.22×10^{-5}
Absolute neutron flux at measurement point, n/cm sec	5.43×10^{8}	5.18×10^{9}	5.70×10^{10}
Mean absolute neutron flux of reactor, n/cm sec	2.68×10^{8}	2.56×10^{9}	2.82×10^{10}
Reactor power, kW	7.72×10^{-2}	7.34×10^{-1}	8.09
Power meter calibration A/kW	2.85×10^{-7}	3.00×10^{-7}	2.72×10^{-7}

*The ionization chamber of the power meter is located in the inner port of the pressure enclosure (13 DS); the measurement error of neutron flux is ± 5 percent

Table 2. Relationship Between Power Meter Readings of the Inner and Outer Ionization Chamber Ports

$\frac{1DS}{13\ DS}$	$\frac{6DS}{13DS}$
0.86×10^{-4}	2.32×10^{-4}

The nuclear power measurement obtained by the physical method can be used to calibrate the power meter of the ionization chamber which is located in the

inner port of the pressure enclosure (13DS, Figure 1), and the results are also presented in Table 1. The mean value of the three different measurements is 2.86×10^{-7} A/kW.

As the reactor power increases, the ionization chamber must be moved from the inner port to the outer port of the pressure enclosure (1DS and 6DS). Therefore, in order to extrapolate the calibration results from low-power to high-power conditions, one must establish the relationship between power meter readings for the two cases where the ionization chamber is located inside and outside the enclosure. Table 2 presents the measured values of this relationship.

From this table, the physical calibration of the power meters where the ionization chamber is located outside the pressure enclosure can be readily computed: for the 1DS meter, 2.46×10^{-11} A/kW, for the 6DS meter, 6.64×10^{-11} A/kW.

If the calibration results obtained under this low-power, cold-state condition are to be extrapolated to high-power operating conditions, the effect of temperature variation of the reflecting layer should be taken into consideration because as the temperature rises, neutron leakage from the reactor core increases; even when the power level is stabilized, the power meter readings will continue to increase. For the loading condition of the No 1 furnace of the HFETR, the relation between power meter readings and reflecting layer temperature can be calculated (Figure 4), and can be expressed in the form of a temperature correction formula:

$$D(T) = \frac{D(T_0)}{1 + 0.0015 \times (T - T_0)} \tag{2}$$

where $D(T_0)$ and $D(T)$ are respectively the power meter readings corresponding to the temperatures T_0 and T of the reflecting layer.

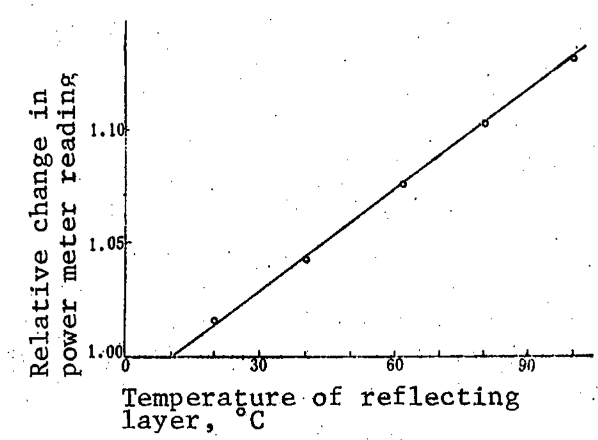


Figure 4. Relationship Between Power Meter Reading and Temperature of the Reflecting Layer

Table 3. Experimental Results of Power Calibration

Control rod lift height, mm		Reflecting layer temperature	6DS power meter readings, 10^6 A			Nuclear power $P_{nuclear}$	Temperature difference between coolant entrance and exit	Coolant flow rate in main circuit	Thermal power, $P_{thermal}$	$P_{nuclear}-P_{thermal}/P_{nuclear}$
3SB/6SB	4SB/7SB	°C	Uncorrected value	After temperature correction	After rod position correction	kW	°C	T/h	kW	percent
1000/1000	550/520	18.8	0.33	0.328	0.278	4,187	0.958	3,780	4,211	-0.5
1000/1000	500/500	20.0	0.66	0.654	0.557	8,389	1.800	3,780	7,912	+5.7
1000/1000	500/500	21.9	1.30	1.235	1.094	16,477	2.79	3,780	16,658	-1.1
1000/1000	450/450	24.0	2.00	1.971	1.690	25,454	5.22	3,780	22,943	+9.9
100/10000	450/450	26.3	2.60	2.553	2.189	32,967	7.235	3,780	31,800	+3.5
1000/1000	470/470	27.7	3.00	2.939	2.513	37,347	8.538	3,780	37,527	-0.8
1000/1000	540/520	29.9	3.60	3.516	2.981	44,895	10.29	3,780	45,228	-0.7
1000/1000	600/600	31.6	4.00	3.897	3.271	49,269	10.65	3,780	46,810	+5.0
1000/1000	650/650	32.8	4.30	4.182	3.488	52,530	11.375	3,780	50,000	+4.8
1000/1000	650/650	33.7	4.60	4.468	3.725	56,099	12.623	3,840	56,363	-0.5
1000/1000	750/750	33.5	5.00	4.872	3.969	59,774	13.59	3,840	60,681	-1.5

The removal and insertion of control rods will affect the neutron flux at the ionization chamber ports. Therefore, if the calibration results at low-power conditions are to be used under high-power conditions, a correction must be made because the control rod positions for the two cases are different. The effect of raising and lowering the six compensation rods on the power meter readings were calculated using the (X,Y) two-dimensional diffusion program. The calculated results can be expressed in the form of a correction formula for rod position:

$$D(h)=\frac{D(h_0)}{1+\sum_i a_i[\eta(h_0)-\eta(h)]}, \qquad (3)$$

where D is the power meter reading; h is the lift height of the control rod in cm; $\eta(h_0)$ and $\eta(h)$ are respectively the relative control rod efficiencies corresponding to rod heights h_0 and h. Clearly, $\eta(0) = 1$, $\eta(100) = 0$. i = 1,2,3 represent the three groups of compensation rods, i.e., 3SB and 6SB, 4SB and 7SB, 1 SB and 2SB (Figure 1). a_i are the correction factors, which for the HFETR No 1 furnace, have the following values:

$$a_i=\begin{cases} +0.111 & i=1 \\ +0.167 & i=2 \\ -0.167 & i=3 \end{cases}$$

The results of measured nuclear power are presented in Table 3.

2. Thermal Method

The thermal method of measuring reactor power is relatively straight-forward. By measuring the temperature difference between the coolant entrance and exit and the coolant flow rate, one can readily calculate the thermal power of the reactor:

$$P=K\cdot C\cdot\triangle T\cdot G' \qquad (4)$$

where ΔT is the temperature difference between the coolant entrance and exit in °C; G is the coolant flow rate in T/h; $K = 1.162 \times 10^{-3}$ kW·h/kcal; C is the specific heat of the coolant in kcal/kg°C.

It can be seen from equation (4) that the key to measuring thermal power is to measure the temperature difference and flow rate accurately. However, because of the large flow rate and small temperature difference of HFETR, it is difficult to obtain accurate measurement of the two under low-power conditions. In an effort to improve measurement accuracy, for experiments operating at less than 10 percent of the rated power, we do not activate the main pump, but only use one of the emergency pumps (the other is reserved for emergency use) for cooling the reactor core. By adjusting the ball valve of the emergency pump, the flow rate can be maintained between 200 and 600 T/h, which will yield larger temperature difference and result in improved measurement accuracy. In this experiment, the thermal power measurement error is approximately ±5 percent.

During the experiment, the cooling system should be allowed to reach thermal equilibrium. In particular, under low-power and small flow rate conditions, it takes more than 1 hour for the near-200T water inside and outside the pressure enclosure to reach thermal equilibrium. Taking measurements before the system reaches thermal equilibrium will result in large errors.

The results of thermal power measurements are also presented in Table 3. It is seen that for most cases, the reactor power measurements based on the physical and thermal methods are in reasonably good agreement. The measured thermal power of the reactor can be used to calibrate the power meters. Figure 5 is a plot of the thermal calibration results of the 6DS power meter, which shows larger fluctuations in the calibration results at low-power levels and smaller fluctuations at high-power levels. This is primarily attributed to factors such as measurement errors in the temperature difference and flow rate, and the degree of thermal calibration of the 6DS meter, 7.14×10^{-11} A/kW, with the physical calibration value of 6.64×10^{-11} A/kW, the discrepancy is 7 percent.

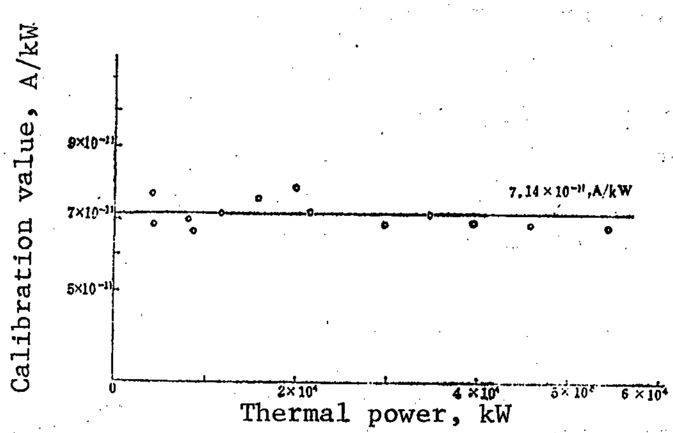


Figure 5. Thermal Power Calibration of the Power Meter

III. Hot Point Monitoring

The operating power of a reactor is determined by the thermal loading of the hot point of the reactor elements. Because of the complicated operating conditions of an actual reactor, it is difficult to predict the power distribution accurately and totally from theoretical calculations and zero-power test results. To ensure safe operation, measures should be taken to monitor the hot point of the reactor. Two monitoring procedures were used in the No 1 furnace of the HFETR.

1. Self-Energizing Probes

Six self-energizing probes are installed inside the water cavities located in the center elements of the reactor core to measure the axial distribution of neutron flux and its absolute value. Based on these measurements, one can determine the maximum surface heat flow at time T from the elements at the core center with peak heat generation:

$$q_i^{max}(T)=C1\cdot K^{(i)}(T)\cdot\phi^{max}(T)\cdot\exp\left[-\int_0^T \sigma_a^5\phi^{max}(t)dt\right] \qquad (5)$$

where the exponential term reflects the effect of burnup; $C_1 = 0.5K\hat{\Sigma}_f d\cdot\bar{\varphi}_{plate}/\bar{\varphi}_{water}$, K is the conversion factor between the units MeV/cm sec and $kcal/m^2h$; Σ_f is the effective macroscopic fission cross section of the fuel plate in cm^{-1},[5] $\bar{\varphi}d$ is the thickness of the fuel plate in cm, $\bar{\varphi}_{plate}/\bar{\varphi}_{water}$ is the average neutron flux ratio between the fuel plate and the water gap; $\phi^{max}(T)$ is the maximum axial neutron flux measured by the self-energizing probes at time T; $K^{(i)}(T)$ is the ratio between the maximum neutron flux of the ith box of element of the reactor core and the maximum axial neutron flux at the probe location at time T, it is determined from the zero-power flux of the water gap, equation (5) must be multiplied by the factor $\bar{\varphi}_{plate}/\bar{\varphi}_{water}$. Figure 6 shows the values of $K^{(i)}$ of the main reactor elements during the initial stage, the mid-stage, and the final stage of reactor operation.

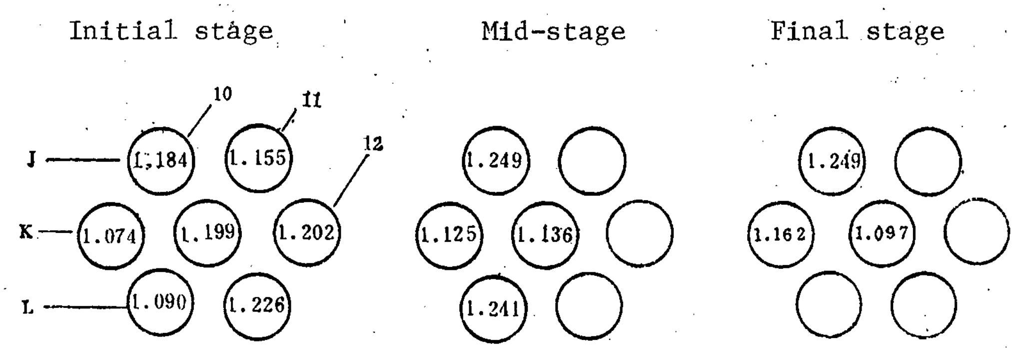


Figure 6. $K^{(i)}(T)$ Under Three Different Conditions

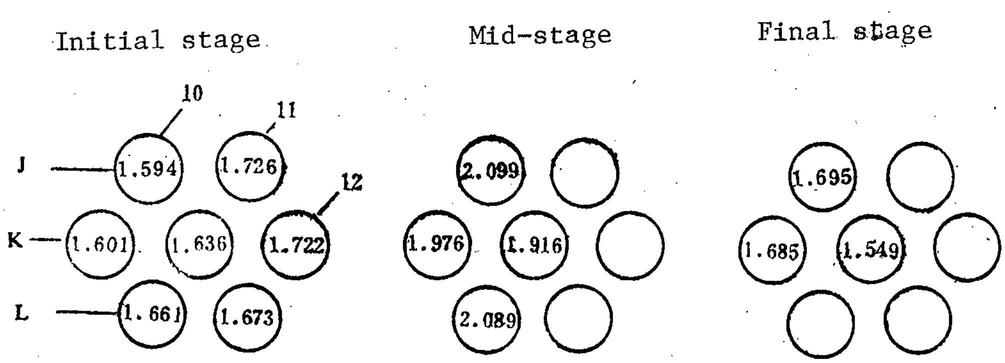


Figure 7. Values of $K^{(i)}$ at Three Different Times

2. Measurement of the Exit Water Temperature

Thermocouples are installed at the cooling water exits of part of the elements of the HFETR core to measure the water temperature. Once the exit temperature of the ith box of element $T_{exit}^{(i)}$ has been measured, the maximum heat flow of this element can be obtained as:

$$q_i^{max}(t) = C_2 \cdot K_i^{(i)}(t) \cdot (T_{出}^{(i)} - T_{入}) \qquad (6)$$

where $C_2 = \varepsilon_2 \cdot C_p \cdot C_p \cdot G^{(i)}/F$, C_p is the specific heat of water, $G^{(i)}$ is the flow rate of the ith box of element in T/h, F is the total heat dissipation in m^2; ε_2 is the amount of heat generated by the element plate as fraction of the total heat content of the box, its value is 0.95; $K^{(i)}(t)$ is the coefficient of power nonuniformity of the ith box at time t, which is determined from zero-power measurements and burnup calculations. Typical values of $K^{(i)}$ during the initial stage, the mid-stage, and the final stage of operation are shown in Figure 7.

Table 4 lists the partial results of hot point monitoring during the operation of the No 1 furnace and compares with the results of thermal measurements ($q_{thermal}^{max}$). q_1^{max} is the monitored value given by the self-energizing probe, q_2^{max} is the monitored value based on the exit water temperature. It can be seen that deviations between the results measured by the self-energizing probes and the thermal measurement results are within ±10 percent. The measured results of the exit water temperatures are generally lower because mixing of the water inside and outside the box takes place, and the water temperature measurements by the thermocouples are affected by different levels of mixing. This leads to generally lower results from equation (6).

The authors would like to express thanks to Comrades Lu Guangquan and Wu Yinghua for participating in the power calibration experiment.

Table 4. Measured Results of Maximum Heat Flow of the No 1 Furnace Core Elements

Reactor Power, MW	29.6	39.4	45.8	52.0	54.2
q_{th}^{max}, 10^6kcal/$m^2 \cdot h$	1.55	2.06	2.38	2.72	2.82
q_1^{max}, 10^6kcal/$m^2 \cdot h$	1.64	2.23	2.64	2.70	3.08
q_2^{max}, 10^5kcal/$m^2 \cdot h$	1.44	1.86	2.17	2.33	2.49

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APPLIED SCIENCES

DEVELOPMENT OF INDUSTRIAL ROBOTS FOR THE AVIATION INDUSTRY

Beijing HANGKONG ZHIZAO GONGCHENG [AVIATION PRODUCTION ENGINEERING] in Chinese No 5, 1 May 85 pp 2-4

[Article by Zhang Chunfen [1728 2504 5381]]

[Excerpts] An industrial robot is an automatic device which can perform many different functions through reprogramming; it is a highly technology-intensive product. The applications of robots are increasing daily, with obvious economic benefits. Robots have received considerable attention around the world because they are producing a major impact on the national economy and on people's lives. It is estimated that there are more than 30,000 robots in the world today (not including non-programmable mechnical arms), and the number is growing at an annual rate of 20-40 percent. As developing industrial robots is one of the major items of China's technology revolution policy, we must do our best to develop this technology.

II. Current Status in China

China's robot research began in the 70's, but for one reason or another, progress was very slow, and the standard was about 20 years behind that of advanced nations. At the present time, there are approximately 100 units of various types of robots, but only a small number are used in production; most still remain in the laboratory. The number of imported robots is also very small, and most of them have not been put to good use.

To develop robots in this country, we should first resolve the following question: with more than 1 billion peple, China is still struggling with problems of unemployment, is there really a need for robots?

Actually, this question indicates there is a misunderstanding about robots. People often regard robot as a device which in the general sense can take the place of human labor, but in fact this is not the case. First of all, a robot is primarily used to do the jobs which are either harmful to human health or rejected by human beings. The "liberated" human beings can devote their energies to cultural activities or to more complicated and more sophisticated work. The use of robots does not pose a threat to employment; compared with the entire labor force, the number of robots is quite insignificant; even in the United States it is only 3 percent, in China it is practically non-existent,

clearly it cannot have any effect on unemployment. Today, some countries have established safety laws which prohibit human beings from working in a poor environment and require that robots be used. China is a socialist country, it places high value on protecting the health of its people, thus the use of robots is quite essential. In this country, there are tens of thousands of people working under very poor conditions (e.g., radioactive, poisonous, explosive, coal mines, high dust level, etc.). In the future, since the primary labor force will consist of people from the "single child" generation, there will be a shortage of labor in these areas, and appropriate measures should be taken as early as possible.

In addition, the use of robots is also essential in cases where very high product quality is required but control is difficult and where extreme working conditions are involved. In short, it is human beings who need robots; robots do not replace human beings.

From the long-range point of view, in order to make China strong and competitive on the world market, it is necessary to develop industrial robots.

The real problem in this country is that China has a huge labor force and low labor cost, whereas the price of robot is quite high. The average salary of a Chinese worker is approximately 1000 yuan per year, yet a simple robot used for transporting costs no less than 40,000-50,000 yuan, which is equivalent to a worker's life-time earnings. A robot used for spot-welding costs more than 200,000 yuan, equivalent to the life-time earnings of five workers. Therefore one is forced to carefully review the economic benefits of the use of robots.

At the present time, there is no reliable and low-cost robots on the domestic market, and there has been no convincing demonstration of useful robot applications. Furthermore, China's technological standard is quite low, and the educational level of the average Chinese worker is so poor that it will be difficult for him to carry out the tasks of robot maintenance and repair. Also, the application of digital control technology and computers which are closely related to robots is still very limited. All these problems are stumbling blocks to the application of industrial robots.

However, with the development of China's four modernizations effort, people are getting a better understanding about the use of industrial robots. In recent years, studies of industrial robots have been very active; progress has been made in the areas of robot research, development and application. New research organizations are constantly being formed; almost all the technical universities have established robot research offices, and many of the industrial organizations, research institutions and factories have also participated in such activities. There has also been an increase in technical exchanges with other countries; during the past two years, more than 10 delegations have been sent abroad to study robots. A number of prototypes have been imported and displayed in exhibitions around the country; technical exchange activities are also being promoted within China's academic community. In short, the trend is now quite clear: the days of a industrial robot revolution in China will not be too far away.

China is currently undergoing rapid economic development. In order to satisfy the needs of the ever-increasing productivity and standard of living, there is a large demand for consumer products such as automobiles, motorcycles, and electric appliances; the demand on quality, variety and market availability is also increasing. To meet these demands requires a highly flexible, automated production line, and the need for robots naturally arises. For example, China's largest automobile factories Yi-Qi, Er-Qi and Nan-Qi have sent delegates abroad to study robots used in automobile production lines. Therefore, the use of robots must be considered whether in renovating an old factory or in building a new production line.

We should take advantage of our large labor force to allow China's industrial products to compete on the international market; industrial robot is no exception. For example, through cooperative production and product back sale, we will be able to not only gain economic benefits but also acquire advanced technology and develop our domestic markets.

There are many situations in China where robots are needed, particularly in poor working environment and under extreme conditions harmful to the human body such as high temperature, high toxic level, high noise level, high dust level, moving heavy objects, underwater, underground, radioactive and dangerous tests. Human beings must be liberated from working under these conditions, and this is where robots should be put to work.

Industrial robot is beginning to blossom in China, and a huge potential market exists. Today, many regions and organizations in China are rushing to develop this technology, with the hope of being the first to control the market in this area. For example, the Chinese Academy of Science, specifically the Shenyang Automation Research Institute has presented argument of the feasibility of robot in the "Robot Demonstration Project", and has listed it as one of the key projects during the period of China's Seventh Five-Year Plan. It has invested 50 million yuan to develop oceanic and rock-crushing robots. The Ministry of Machine Building Industry has initiated efforts at the automation institutes and the machine tool institutes to develop robots for welding, spray-painting and transporting. Other ministries such as the Ministry of Electronics Industry, the Ministry of Industry, the Ministry of Ordnance and the Ministry of Nuclear Industry have also initiated efforts at various levels to develop industrial robots. The Shanghai region is so ambitious that it plans to invest 100 million yuan to develop intelligent machines and robots with the hope of accelerating the reform of Shanghai's traditional industries and technologies.

III. Suggestions for Developing Industrial Robots for the Aviation Industry

The aviation industry is a high-technology industry where industrial robots can be put to good use. In particular, since the future emphasis will be on consumer products, old production lines must be renovated and new production lines must be built, it is quite natural to consider the use of robots.

This ministry began its industrial robot development in the late 70's. For example, the No. 4 Design Institute has successfully developed the Unimate 2000 robot used for precision casting. The Aviation Precision Machine Research

Institute has developed the JJR-1400 and the JJR-300 industrial robots used for feed loading and unloading, and has exported them to Hong Kong and the United States; they are China's only exported commercial industrial robots. The Beijing Aeronautical Institute has done a significant amount of work in robot theory, and has presented many papers at technical conferences both in this country and abroad; it also has three inventions in the area of mechanisms, which include the concentric holding mechanism and the mini-robot "Antelope" with unique mechanism design. In addition, the Beijing Avaiation Technology Research Institute, the Nanjing Aeronautics Institute, the Northwest Polytechnical University, and other factories and offices have also initiated work in this area. In short, this ministry has already built a good foundation for robot research and development; as long as we can strengthen our organization efforts and fully develop our potential in technology and production, there is no doubt that we will be able to achieve a high standard in robot technology in the near future.

A decision has been made by the Ministry of Aviation Industry to develop industrial robots to support consumer products. In order that the Ministry's efforts will result in rapid and positive progress in robot development, we offer the following suggestions:

1) Stimulate robot development through imported technology, support research with production, and develop our domestic market by competing on the international market.

2) The primary objectives of the research and development of industrial robots should be to improve product quality, to increase economic benefits, and to improve working conditions.

3) The main targets of robot development should be those used in poor working environment for the automobile industry and the mechanical processing industry. Specifically, they include robots used for spray-painting, welding, transporting and assembly. Considerations should also be given to provide services for technological reform and improving technical standards for the aviation industry.

4) In the area of applied research, we should first expand the customer base for the robots already developed by this Ministry, and make the necessary improvements according to customer requests; we should begin organized production of certified products. For products which are being developed, we should first use the prototype units in the "demonstration workshop" in order to accumulate experience with the new product; at the same time, we should also devote our efforts to the development and production of complementing and support equipment.

5) Theoretical studies of robots should be carried out by higher institutions and should cover the following areas: theory of motion, theory of mechanism, dynamics, control theory, sensor technology, and artificial intelligence.

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APPLIED SCIENCES

DEVELOPMENT OF PRC AVIATION PRODUCTION TECHNOLOGY TO 2000

Beijing HANGKONG ZHIZAO GONGCHENG [AVIATION PRODUCTION ENGINEERING] in Chinese No 5, 1 May 85 pp 5-7

[Article by Ma Yeguang [7456 2814 1684] and Yang Qiguang [2799 1142 0342]

[Text]

I. The Important Role of Aviation Production Technology in the Aviation Industry and Its Current Development

1. Manufacturing technology is the foundation of technological reform. Today, China's aviation industry and other industries are faced with the urgent problems of technological reform, product improvement, and increasing economic payoff. Without advanced manufacturing technology, it is inconceivable that technological reform of the aviation industry can be achieved.

2. The standard of manufacturing technology is a good indicator of how design standard may be achieved. Advanced manufacturing technology provides more options to the designer during the design process; on the other hand, new requirements on product performance provide incentives for the development of manufacturing technology. The history of aviation development is filled with examples of mutual stimulation between design and manufacturing.

3. Aviation manufacturing technology plays a major role in improving product quality, reducing production cost, and shortening the research and development cycle.

In western countries, design and manufacturing are traditionally placed in the same engineering department. The objective of design is to meet certain aircraft performance specifications, and manufacturing technology is the foundation for achieving the design objective. Based on China's experience during the past 3 decades, it has been shown that rapid development of the aviation industry is not possible without devoting considerable efforts to the study of manufacturing technology.

The current development of aviation manufacturing technology can be summarized as follows:

1. Integrated application of multiple disciplines. As an example, the application of bonding technology to aircraft structures requires first knowing the location and the function of this structure on the aircraft, analyzing its stress condition, understanding the design objective, choosing the bonding compound and preparing the core material, and carrying out a series of procedures such as coating and pressing, solidifying and molding, machining, connecting, repairing and testing; in addition, a set of special-purpose equipment such as bonding machine, core material stretching machine, thermal press equipment, high-pressure water-cutting machine tools, honey-comb machine tools and ultrasonic test instrument, etc. must be developed. In other words, it involves technologies in many disciplines including physics, chemistry, computers, hydraulic transmission, ultrasonic and sonic emissions, etc. Only through integrated use of these technologies can we solve the complicated problem of bonding structures. This approach of technology concentration is by no means novel, but it has become more important today.

2. Rapid response capability. This is an indicator which reflects the inner quality of the system. The traditional aircraft manufacturing technique is based on the method of mode profiles and templates. It has the unique feature that the dimensional data are passed from one link to another in the manufacturing chain. A change in one of the links will cause a series of changes in other links; also, the system response is very slow. The introduction of computers led to the development of a series of new technologies such as digital control technology, automatic programming language system, automated graphics technology, interactive graphic display technology. Thus, the method of profiles and templates has been replaced by a method of interactive real-time operation. Starting from the establishment of a digital product model, all designs, drawings, and processing operations can be carried out in parallel, and can be modified according to needs. This facilitates multi-scheme, multi-parameter optimization, and also provides highly flexible, rapid response capability.

3. Emphasis on real economic and technical benefits. A robust new technology would be useful in production only if it has obvious economic and technical benefits. But it is difficult to separate economic benefits from technical benefits. For example, to increase the thrust of a jet engine requires raising the turbine temperature; but if the operating temperature exceeds the temperature limit of the engine material, increasing the temperature further would require improving the structural design and other technical measures. As a result, the gas-film cooling technique was developed; a key to the success of this technique was the pin-hole machining process. By using this technique, the temperature of the blade surface can be reduced by 200-300°C, hence the development and application of pin-hole machining process is essential to engine manufacturing technology, and provides a good example of the happy marriage between economic and technical benefits.

4. Engineering information management of manufacturing technology. In the production of the F-16 aircraft, the (wo-si-bao) Co. initially estimated a

total production time of 116,000 man-hours. By improving management and re-arranging production facilities, the wasted motions of parts flow were reduced; also, by using straight-line, short-distance production lines, the transfer time and waiting time of parts were minimized. As a result, the total production time was decreased to 32,000 man-hours, and large savings in production cost significantly enhanced the competitive position of the F-16 on the world market.

II. An Assessment of the Current Status and Projected Status for the Next 15 Years

1. During this period, a systematic reform of the economic system will be carried out around the nation. In terms of technical content, computer technology will play a more important role in management. Computerized interactive information systems will be used to provide complete information and data to the decision makers so they can carry out the tasks of production organization, planning management, and procurement and replacement of equipment in an accurate and timely manner.

2. During the next 15 years, China's aviation manufacturing industry should establish a capability of research and development of new fighter aircraft, and produce selected models of military aircraft for actual service.

While it is very important to absorb advanced technologies from abroad to raise China's standards of research and development, our main emphasis should be to improve our own capability of research and development. We cannot buy aviation modernization from others and the price tag is likely to be too high.

3. Lack of coordination between training and utilization of human resources may lead to grave consequences. We are primarily faced with the following problems: 1) In the mid 90's, a large number of key personnel will be retiring from service, but the college students produced by China's institutions in recent years will be far short of meeting this need both in quantity and in quality. This imbalance between supply and demand will be a critical problem for a long time to come. 2) The specialization offered by colleges and universities are too narrow in scope. 3) There will be an extreme shortage of management personnel with specialized training.

4. In the internal relations of manufacturing technology, the imbalance between the development of manufacturing technologies for primary and auxiliary machines will continue to exist. Both production and certification will be adversely affected by inadequate auxiliary machines.

III. Suggested Key Tasks for the Next 15 Years

1. Develop computer technology, particularly in the areas of integrated systems and coordinated development of hardware and software. Solve the problem of software engineering and standardization, and develop software into a marketable product. Study the techniques of computer network in order to fully develop the potential of large, mini and micro computers under unified data structure and data base management.

In the area of hardware, the design and manufacturing of digitally-controlled machine tools should be closely coordinated with utilization and maintenance. Using 3 and 5-coordinate machine tool as a basis, develop large-scale multi-coordinate planer type milling machines and digitally-controlled processing centers of different sizes in order to provide a firm foundation for various applications in the aviation industry such as design and research, production and manufacturing, and industrial management. By the year 2000, factories with primary CAD/CAM systems should be established in order to achieve the goal of shortening the aircraft research and development cycle by 1-2 years.

In the area of software, efforts should be devoted to the development of CAGD (contour model), CAD (computer-aided design and analysis), CAM (manufacturing), CAMM (management) and EDS (data storage). In CAM, control software should be developed for manufacturing plate metals, titanium alloy structures, composite structures, metallic or non-metallic bonded structures, and for special manufacturing processes. In addition, research and development of graphics work stations, flexible manufacturing systems (FMS), and robots should be initiated.

2. The development and application of manufacturing techniques for composite structures will be a task of strategic importance during the next 15 years. In addition to carbon fibers and synthetic fibers, attention should also be given to the manufacturing techniques of boron-fiber and metallic-fiber structures. Today, China already has the capability to manufacture composite-material vertical tails; it is gradually developing manufacturing techniques for wings and fuselages. By the year 2000, it is predicted that 15 percent of materials on new aircraft will be composite materials. To reach this goal, we must do the following:

(1) study the manufacturing techniques and equipment for pre-soaked materials;

(2) study the cutting techniques and equipment for composite materials, and develop high-pressure water-cutting machine tools;

(3) study techniques and equipment for laying composite materials, and develop multi-coordinate, digitally-controlled spreading [?] machines;

(4) study computer-aided laying techniques and develop the necessary software;

(5) study curing techniques, and develop special-purpose curing equipment; establish curing specifications;

(6) study joining techniques, cutting processes, non-destructive inspection techniques and repair procedures for composite materials.

3. Manufacturing techniques for titanium-alloy structures. The F-15 aircraft uses 2.9 tons of titanium-alloy components, the MIRAGE aircraft uses 1.8 tons, but the amount of titanium alloy used on domestic aircraft generally does not

exceed 100 kg. By the year 2000, it is estimated that the total structural weight of new aircraft will have more than 10 percent titanium alloy. To meet this goal, we should do the following:

(1) in the forming of titanium plates, we should not only master such techniques as forming corrugated plates, rubber forming of skins, deep stretching, pressure caving and bending, but also study the techniques of rotary press of titanium materials;

(2) solve the problem of extending the life of high-temperature templates used in forming titanium parts, study protective coating techniques and establish tolerance specifications for titanium parts;

(3) study the implementation of micro-computer-controlled, fully automated forming process;

(4) emphasize quality control and test procedures of titanium structures;

(5) study the integrated procedure of super-plasticity-diffusion joining process of titanium parts.

4. Metal bonding technique. Bonded structures can reduce the cost by 30 percent and the weight by 40 percent. We should improve the standard of the current bonding technique to ensure product quality. A key issue is to maintain strict control of the bonding environment, i.e., to ensure cleanliness of the workshop and to improve the control of temperature and humidity. Regulations and standards of bonding techniques and serialization of bonding equipment should be established. The next step is to study high-endurance bonding compounds, annodization of phospheric acid, and corrosion-resistant bonding primers.

5. Study of advanced welding techniques. We should accelerate the development of high-energy (electron-beam, plasma, laser) welding techniques and equipment, as well as special welding procedures. The problem of welding and inspecting titanium honey-comb structures should be solved, and protective gas welding equipment and techniques should be implemented as soon as possible. Also, we should devote efforts to the study of the mechanism of welding stress deformation, and develop a method of controlling and preventing stress deformation.

6. Coating techniques. We should expand the use of hot-jet coating technique on aircraft engines. Experimental research is now under way to develop wear-resistant, impact-resistant coatings as well as wearable sealed coatings. In the area of high-energy, vacuum plasma spray-coating techniques, a 5-coordinate platform should be developed in order to achieve uniform spray-coating of complex structures.

7. Special processing methods. We should continue to do research in methods of laser processing, electron-beam processing, electrolysis processing, ultrasonic processing, and ion-beam processing; we should also pay attention to the problem of surface integrity in parts processing.

8. The problem of surface integrity of difficult-to-process materials should be studied, and a cutting data base for China's aviation industry should be established. Priority should be given to the study of new cutting tools, new cutting fluid, and cutting techniques for titanium alloys and new high-temperature alloys.

9. Auxiliary machine techniques. We should carefully fine-tune and analyze the techniques for auxiliary machine production. We should stress the coordinated development of precision and ultra-precision processing techniques and solve the problem of applying various grinding techniques.

10. We should devote our research and development efforts to improving measurement and test procedures and discard the passive technique of product inspection. We should apply multi-parameter control and use real-time information feedback in the manufacturing process to ensure product quality.

We should build an aviation test center, establish plans and implement the necessary measures to develop inspection test procedures for bonded structures, composite structures, and welded structures. We should also study laser holographic techniques, micro-focus techniques, soft X-ray techniques, ultrasonic and sound-emission techniques, C-scan techniques, vibration and vibration-analysis techniques, and apply them to scientific research and production; in addition, we should provide the necessary manuals and handbooks.

3012/12379
CSO: 4008/9

LASER EXERCISE REMOTE CONTROL SYSTEM DEVELOPED

OW260327 Beijing XINHUA Domestic Service in Chinese 0011 GMT 24 Nov 85

[By Reporter Li Anding]

[Excerpt] Beijing, 24 Nov (XINHUA)--A telemetering and remote control system, modern military equipment at advanced world level, which is indispensable for laser military exercises, has been jointly developed by the Haihua New Technology Development Center and the Radio and Electronics Department of Qinghua University which have been entrusted by the Military Training Department under the PLA General Staff Headquarters to develop the equipment. The system has been successfully used in the PLA's first simulated laser and electronic combat exercise and lauded by the central authorities' leading comrades.

Domestic military and electronic experts maintain that the successful development of a system which can telemeter and remote control multi-point and movable, changeable targets in a laser beam exercise is a major breakthrough in China's military training technology.

The laser electronic simulated combat exercise is a new achievement currently being developed in only a few nations. It uses laser beams and electron waves to replace real ammunition in military exercises. Both sides in the exercise carry weapons which can emit laser beams and electron waves, as well as receivers for those waves. When the laser beams emitted by the weapons on one side hit the other side, colored smoke is immediately emitted from helmets worn by personnel on the other side, and at the same time weapons in the hands of soldiers on the other side are immediately rendered ineffective. In this kind of exercise, fighters on both sides can engage in real combat face to face, thereby making the exercise more realistic. However, in the absence of a telemetering system, commanders cannot make accurate assessments of the real situation in terms of win and loss to readjust their deployment strength. The telemetering and remote control system newly developed for the laser exercise is the result of integrating telemetry and remote control technology with computer technology. The system is controlled by a computer to individually monitor small transmitters carried by each participant in the exercise, and determine whether a participant has been hit. During the exercise, changes in combat strengths on both sides are constantly shown on the computer screen.

The project was a scientific research task proposed by the PLA General Staff Headquarters, and was developed under a contract signed between the Simulator Research Institute for Military Exercises in the Shenyang Military Region and the Haihua New Technology Development Center.

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APPLIED SCIENCES

WIDE-RANGE TUNEABLE LASER SYSTEM DEVELOPED

OW271050 Beijing XINHUA in English 1033 GMT 27 Nov 85

[Text] Beijing, 27 Nov (XINHUA)--Chinese scientists, after 3 years of effort, have developed a YAG-dye-raman wide-range tuneable laser system, which passed a technical appraisal test here today.

The system, only produced by a handful of companies so far, in the United States, France, and Britain, was one of China's major scientific research projects during the Sixth Five-Year Plan period (1981-1985). It has wide applications in the fields of laser spectrum, nonlinear optics, materials science, separation of isotopes, pollution monitoring, biology, genetic engineering, and the defense industry.

Over 60 experts attending the appraisal meeting believed that the development of such a system has filled a gap in the country's laser technology, and its technical level is up to that of similar foreign products of the early 1980s.

The new laser system has been jointly developed by the Institute of Physics under the Chinese Academy of Sciences, the No 11 Research Institute under the Ministry of Electronics Industry, and the Radio and Electronics Department of Qinghua University.

/9604
CSO: 4010/19

APPLIED SCIENCES

ELECTRICAL EXCITING TECHNIQUES FOR SIMULATING SYSTEM-GENERATED EMP

Beijing HEDIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No 5, Sep 85 pp 280-284

[Article by Peng Guixin [1756 6311 2450]: "Electrical Exciting Techniques for Simulating System-Generated EMP"]

[Text] Abstract: This paper introduces some fundamental knowledge of simulating SGEMP and simulating techniques are discussed in terms of basic electromagnetic response parameters. The simulating method is based on Maxwell's equation and its basic symmetry relationships.

Electrical exciting techniques assume that the source term J is expressed as incident fields or current carrying conductors. This paper has compared various electrical exciting methods with respect to the source terms, relevant equations and boundary conditions of each technique.

(Key words: SGEMP, electrical exciting techniques for simulating SGEMP)

System-generated electromagnetic pulse (SGEMP) is a term used to describe the electromagnetic field and the transient current which are produced by the interaction of gamma-rays and X-rays with the structure and electric cables of a system, it is an epigenetic current and electromagnetic field which is produced by radiating electrons on the surface of an independent body when exposed under light pulse conditions. Some documents add the word "outer" before SGEMP.[1] The electromagnetic field which is produced within this cavity by photons which are radiated from the walls of a cavity is called the inner electromagnetic pulse (IEMP), if the photons act on the electric cable and the current is excessive in a negative load, then it is called an injection current.

The SGEMP of nuclear explosions is a great threat to satellites and guided missiles flying in the upper air. To determine the ability of flight vehicles to survive in the environment of a nuclear explosion, it is necessary to conduct a large number of SGEMP simulation tests. The most ideal SGEMP simulation begins with photon simulation, for example, a pulse photon source such as an X-ray machine is used for the radiating system thus causing it to emit photons. Thus, the unit area number of photons, spectrum, and wave forms are all very important, and should be close to the gamma and X-rays produced by a

nuclear explosion. Unfortunately, it is currently still impossible to produce the energy spectrum, dosage, and pulse form photons of threatening degree on areas which are the equivalent of the total dimensions of satellites and guided missiles. One method is to use electrical excitation technology to simulate this environment, and then extrapolate from the test results.

I. Fundamental Explanation of SGEMP

The important distinction between SGEMP and EMP is that the electron source of SGEMP excitation Maxwell equation is the system itself and not the surrounding air or other matter. When incidence photons bombard flight vehicles, the Compton electrons and photons can be emitted from their different surfaces, and the transient process of the current created is called replacement current or displacement current. The overall SGEMP phenomenon can be described with Maxwell's equation, when $t = 0$, all fields are zero; when $t > 0$, the electron and magnetic fields are determined by the following equations

$$\Delta \times \vec{E} + \mu \ \partial \vec{H}/\partial t = 0 \tag{1}$$

$$\Delta \times \vec{H} - \varepsilon \ \partial \vec{E}/\partial t = \vec{J} \tag{2}$$

This is because the influence of the conductor boundary demands that the tangential component of the electron field on the entire conductor surface be zero, i.e., on the conductor surface $\hat{n} \times E = 0$. $\hat{n}$ is the unit vector perpendicular to the surface.

The output of the above calculations is the $\vec{E}$ and $\vec{H}$ values on the space mesh points. Later, the values of the conductor surfaces in the vicinity of these fields were used to determine the skin current and charge density on the conductor, the correlated equations being:

$$\hat{n} \times \vec{H} = \vec{K} \qquad \hat{n} \cdot \vec{E} = \sigma/\varepsilon \tag{3}$$

in which $\vec{K}$ is the skin current density, A/m; σ is the surface charge density, C/m^2. $\vec{K}$ is a variable identical to the replacement current concept. $\vec{K}$ is often used as the basic standard for identifying SGEMP response, but relying on just $\vec{K}$ alone is not considered suitable, therefore the charge density σ should also be taken into account. Thus, as soon as the boundary conditions are determined, the space current $\vec{J}$ will be the determining factor of $\vec{K}$ and σ, in other words, $\vec{J}$ is the source which gives rise to the electromagnetic field.

The space current density $\vec{J}$ is a function of space and time, $\vec{J} \equiv \vec{J}(\vec{r},t)$. Supposing $t = 0$, and $\vec{E}$ and $\vec{H}$ are both at zero, then Equation (2) demonstrates that $\vec{J}$ primary action produces an electrical field in the opposite direction from $\vec{J}$, i.e., $H \approx 0$, $\nabla \times \vec{H} = 0$, then Equation (2) becomes

$$\vec{E} = -\frac{1}{\varepsilon} \int_0^t J dt' \tag{4}$$

The relationship between $\vec{H}$ and time given in Equation (1)

$$\frac{\partial H}{\partial t}=-\frac{1}{\mu}\nabla\times\vec{E}\approx\frac{1}{\varepsilon\mu}\int_0^t[\nabla\times\vec{J}]\,dt' \tag{5}$$

There are several points that should be noticed in Equations (4) and (5): first of all, $\vec{E}$ is only related to the time integral of $\vec{J}$, and H is determined by $\nabla \times \vec{J}$, i.e., the magnetic field is related to the emitted current density transverse gradient. This space gradient is important in studying the influence of various geometrical shapes. For example, in spherical symmetry (i.e., emitting evenly from the entire surface of a spherical body), even if a large radial electron field and surface charge density are produced, it is also $\nabla \times \vec{J} = 0$ and no skin current is produced. Conversely, emitting evenly radially from a hemisphere, a non-zero value of $\nabla \times \vec{J}$ will be produced on the edge of the emission area, i.e., a magnetic field will be produced at that point.

When deriving Equations (4) and (5), supposing the $\nabla \times \vec{H}$ in Equation (2) is very small and we combine Equations (1) and (2) to get a more precise expression

$$\nabla^2 H-\varepsilon\mu\frac{\partial^2 H}{\partial t^2}=-\nabla\times\vec{J} \tag{6}$$

$$\nabla^2\vec{E}-\varepsilon\mu\frac{\partial^2\vec{E}}{\partial t^2}=\frac{\partial\vec{J}}{\partial t}+\frac{1}{\varepsilon}\nabla\rho=\frac{\partial\vec{J}}{\partial t}+\frac{1}{\varepsilon}\nabla\left[-\int_0^t\nabla\cdot\vec{J}dt'\right] \tag{7}$$

In Equation (7), the charge continuous equation already links the space charge density ρ and the space current density $\vec{J}$. Equations (6) and (7) are merely two nonhomogeneous wave equations of different form, and their solution must be influenced by the assumed initial conditions and boundary conditions. This is because $\vec{E}$ and $\vec{H}$ were at first zero, and the right hand terms of Equations (6) and (7) are the fundamental excitation terms of this wave equation. Thus, in these precise expressions, if $\nabla \times \vec{J}$ is zero, $\vec{H}$ will remain at zero throughout. Similarly, if $\partial\vec{J}/\partial t$ is zero, the electric field will not change.

These questions show precisely that there is a relationship between the electromagnetic field produced by the SGEMP effect and $\vec{J}$'s temporal process and space distribution. In particular, the magnetic field $\vec{H}$ (i.e., the skin current $\vec{K}$) and $\vec{J}$'s transverse gradient (i.e., $\nabla \times \vec{J}$) are related. Thus, the geometrical shape of the electron emission is very important in determining $\vec{K}$. We have discussed primarily only changes in the electromagnetic source term $\vec{J}$. But, the boundary conditions of system conductor also are very important. The complexity of a system's geometric figure can only be approximated by a model, i.e., even if these boundary conditions are not very clear or cannot be determined, the true boundary conditions of height exist.

The SGEMP electromagnetic effect can also be studied using the general excitation test method, thus it is not necessary to carry out photo pulse bombardment SGEMP tests which are expensive and hard to solve. Another rather close

simulation of SGEMP is to use plasma.. This is produced by the explosion metal wire bundle, and is much more effective than the lengbarenzhi [0397 7249 7282 5268] radiation process. This technology is still being developed. In addition to this, electron beam devices can be used to simulate SGEMP and IEMP. The primary devices are the SPI-5000 and SPI-6000.

II. The Cylindrical SGEMP Concept

First of all, we studied the concept of a simple cylindrical SGEMP. The cylinder illustrated in Figure 1 was placed under photon emission, and the photons emitted from the front outer surface formed an electron cloud. The cylinder was axially symmetrical, and this axis was parallel to the propagation direction of the incidental photons. The electric field lines reverse direction go to the electron cloud, i.e., the field lines oppose those electrons in space, and thus the field lines which begin behind the body (the emitting side) in the end are on the "outer edge" of the electron cloud, and are opposite to the field lines which come from the emission surface in terms of space electrons.

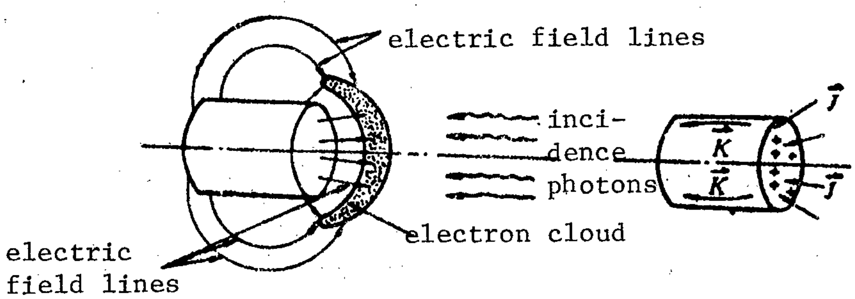

Figure 1. Concept of Cylindrical Test SGEMP Excitation
Left: Cylindrical shape and electric field structure
Right: $\vec{J}$, $\vec{K}$ and surface charge density (marked by +)

III. Electrical Excitation Techniques

1. Plane Wave Excitation

The test object was placed in a boundary wave EMP simulator. The simulator produced a plane wave excitation like the wave form illustrated in Figure 2 of the test object illustrated in Figure 3. We assumed the boenting [3134 1869 1656] vector direction was the same as the propagation vector direction of incidence photons under SGEMP conditions. This simulation method conformed to demands, because the system tested eliminated source influence and could carry out a full dimension test. Yet the plane wave excitation principle is different from SGEMP. The geometrical shape illustrated in Figure 3 is symmetrical to the plane formed by the electric field vector and the propagation direction of the incidence photons. This is because the plane wave excitation is always related to two directions--the boenting vector and the polar vector. Figure 4 illustrates the difference between the plane wave excitation and SGEMP excitation situations. K_{xr} represents the SGEMP plane current, K_z, K_ϕ, and K_ρ represent, respectively, the surface wave excitation's

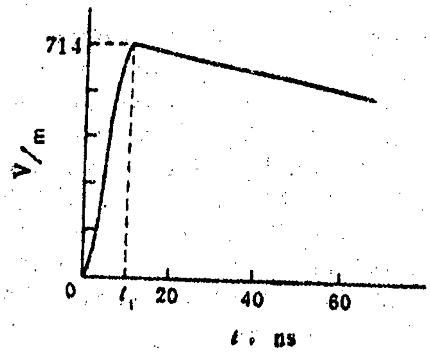

Figure 2. Plane Wave Excitation Waveform

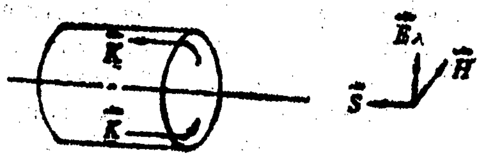

Figure 3. Plane Wave Excitation Cylinder

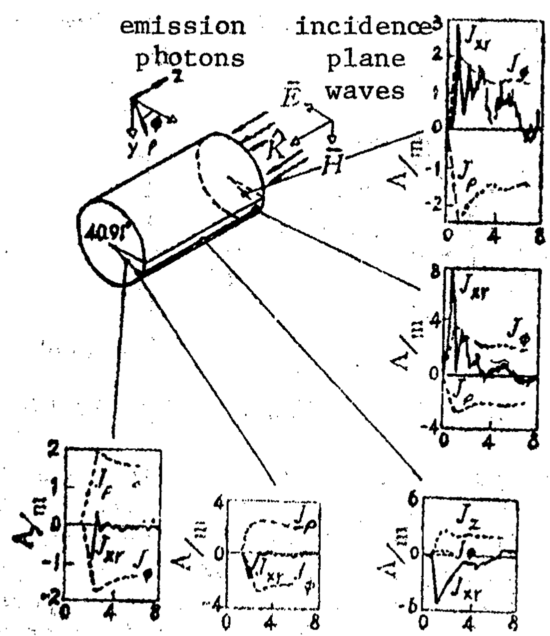

Figure 4. Comparison of the K_z, K_ϕ, and K_ρ Induced by SGEMP K_{x1} and Plane Wave From Incidence at One End of a Cylinder

axial surface current, circumferential surface current and radial surface current. There are three clear differences between them: 1) Using the plane wave excitation produces an unanticipated excess surface current K_ϕ. Exciting a cylinder with X or gamma rays from one end only produces a radial current K_ρ on the end plate and an axial current K_z on the cylinder but does not produce a circumferential current K_ϕ. 2) SGEMP includes a higher frequency component, i.e., K_{xr} ascending time is fast. 3) Plane wave excitation produces a "shadow" effect and the zero value or maximum value of skin current and surface charge density which appears is completely different fromt that produced by SGEMP. In addition, the phase is different, too.

2. Monopole Near Field Excitation

The test system was placed along the axis of a monopole antenna, which was of the geometrical shape illustrated in Figure 5. The incidence magnetic field was rather small. Under these near field circumstances, the incidence electric field lines almost followed the direction of propagation. We had to place the test object fairly close to the antenna which was emitting the incidence field because what we were using was a nearby field and this field decays especially fast with distance. The test object probably has to be situated within the dimensions of one or two special antennas to obtain suitable field intensity. If the test object is placed very close to an antenna it is possible for an electrophonic effect of the changed system to appear due to coupling of the test object and the antenna.

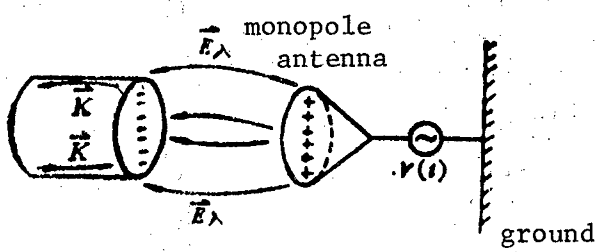

Figure 5. Near Field (Monopole) Excitation

This kind of near field monopole excitation technology can duplicate the SGEMP skin current distribution very well. Using this excitation technique, the surface charge distribution on the front surface of the test object has opposite symbols from the actual emission electron's SGEMP. This symbol change is to obtain true flow in the skin current direction, and to approach the emission surface's electrical field in this way is only possible if it is in the opposite direction from the SGEMP situation. To obtain the current flowing towards the back side, the incidence electric field must "attract" electrons to the front side of the test object.

3. Mixed Wire and Capacitor Injection Technology

This type of injection technology is a combination of hard wire current injection and capacitance coupling, as illustrated in Figure 6.

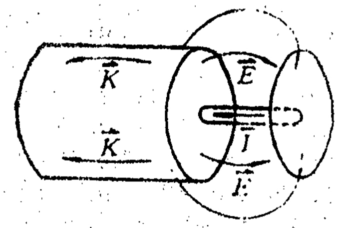

Figure 6. External Shape of Combined Hardwire and Capacitor Excitation

The current is injected along the hard wire linking the test object to the conduction plate. The conduction plate is close enough to the test object to form capacitance coupling. Because the current flows along the wire from the test object, when the plate at the opposite pole is full, a displacement current is established. In addition to points in the vicinity of the wire, between the test object and the polar plate an electric field and a field very similar to the one established under SGEMP conditions are induced; furthermore, the displacement current induced frequently contributes to compensation emission current. If the conductor approaching the test object is placed along the equipotential surface of an SGEMP situation, it will display a nearby electron cloud.

A resistance type negative load wire was used to link the test object to an external capacitor plate. Because the capacitance tested between poles and the inductance of the wire formed a dampled oscillation circuit, this resistance type negative load, was used to reduce the unnecessary oscillation to a minimum. This resistance is probably selected at the critical damping degree.

If I is the current on the wire, V is the voltage between the test object and the external poles, then $I \approx C\, dV/dt$. Here, C is the capacitance between the poles and the test object. The relationship between the electric field and the voltage is $V = - \int \vec{E}\, dl$. Therefore, $\partial E/\partial t \approx -KI$. Here, K is a constant, related to capacitance and other geometric factors. If I is made equal to the total current emitted in SGEMP circumstances, then $I = \int_A \vec{J} d\vec{A}$. Here, A is the emission area, thus $E \approx \int_0^t \vec{J} dt'$. This approximates the dependency relationship of the SGEMP situation given in Equation (4). Using suitably shaped external poles, one can approximate the space distribution of the simulated electric field. That is, $\nabla \times \vec{E}$ is roughly correct, and based on Equation (1) we obtain the magnetic field's "suitable" time derivative $\partial H/\partial t = -\nabla \times E/\mu$.

Although the electromagnetic field produced by combined excitation of wire and capacitor approximates the SGEMP situation qualitatively, the degree of qualitativeness is not ideal. For example, in the vicinity of the wire, the magnetic field is fairly large and the electric field is very small, and in addition, the capacitor poles are large relative to the wavelength studied, and at this time the capacitor concept is not established, and there may be harmonics induced at the poles.

When designing these electrical excitation methods, $\vec{J}$ was the source condition of the excitation Maxwell equations. It was restricted by the boundary conditions added to the test system, the response always is characterized by the

induced surface wave current density $\vec{K}$ and the surface charge density σ. Thus, SGEMP simulation becomes a problem of duplicating the $\vec{K}$ and σ produced by the system. Electric excitation technology envisions using some incidence field equipment or carrier conductor to represent the source condition $\vec{J}$, hoping to duplicate the source conditions very close to the SGEMP situation. However, without changing the electromagnetic boundary conditions, it is very difficult to simulate $\vec{J}$. For example, fields approaching capacitor poles or in-circuit short-circuit tangential to other surfaces. In surface wave excitation technology, incidence surface waves have a basically symmetrical nature, and the test object responses invoked are very different from those of the SGEMP situation. However, one cannot for this reason determine that electric excitation technology is not a practical simulation tool. This is because whether or not it is useful depends on the goal we want to achieve. For example, although an "incorrect" field is given at one position, if this position is not particularly important, then it can be useful.

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APPLIED SCIENCES

MICROCOMPUTER-BASED MULTIFUNCTION, MINI-MULTICHANNEL ANALYZER

Beijing HEDIANZIXUE YU TANCE JISHU [NUCLEAR ELECTRONICS AND DETECTION TECHNOLOGY] in Chinese Vol 5 No, 5 Sep 85 pp 297-299

[Article by Wang Jingjin [3769 4842 6210], Chen Ying [7115 5391], and Wei Yixiang [7614 5030] of Qinghua University, and Zheng Putang [6774 3302 1016], Zhang Hongrei [1728 3163 3843], Ji Weitong [1323 4850 0681], and Qiu Xuehua [5941 7185 5363] of the Beijing Nuclear Instrument Factory: "Model DD80 Multifunction, Mini-multichannel Analyzer Based on Microcomputer"]

[Text] Key Words: Data Acquisition Interface, Microcomputer

The multichannel analyzers now produced in China are basically made up of specialized hardware, their data-processing functions are inadequate, and most data-processing work is done by other computers. With the development of LSI circuits in recent years, microcomputer functions have constantly increased and their performance/cost ratio has favored their use in nuclear data acquisition and processing systems.

To satisfy the daily increasing need in China for a new multichannel-analyzer, proceeding from China's actual situation, together we developed a small microcomputer-based multifunction, multichannel analyzer. In design, new technology, small systems, and economic reliability were taken as the guiding principles.

I. Proposal Selection

The multichannel-analyzer structure could use either a special-use computer or a general-purpose computer. The former is a multichannel-analyzer host computer which is made up of a microprocessor and other integrated-circuit chips and which has data acquisition and processing functions, has the program burned into memory, and is operated by special keys; the latter is made up of a general-purpose computer with an interface and a software which is operated by means of a keyboard and man-machine dialogue.

Each of the two proposals has its advantages and disadvantages. Taking into consideration present technological conditions in China, the proposal to choose a general-purpose computer is more suitable because it has the following clear advantages:

(1) Because it has powerful and flexible data-processing functions, a special-purpose computer with a multichannel analysis program burned in would be very hard to supplement or revise. Conventional multichannel, general-purpose software is sometimes hard to adapt to actual needs, thus making revisions and supplements unavoidable. Furthermore, if the user wants to develop his own software, it would be extremely difficult to realize on a special-purpose computer, but it would be extremely convenient on a general-purpose computer.

(2) Making a multichannel analyzer out of a general-purpose computer which has the double functions of a multichannel analyzer and a computer, although it is one instrument, when not being used for data acquisition it can be used for computing, thus fully exploiting its functions.

(3) Development time is short, Using a general-purpose computer can same development work on the computer itself, requiring only development of the interfaces and software. Thus the scientific research and production cycle is short.

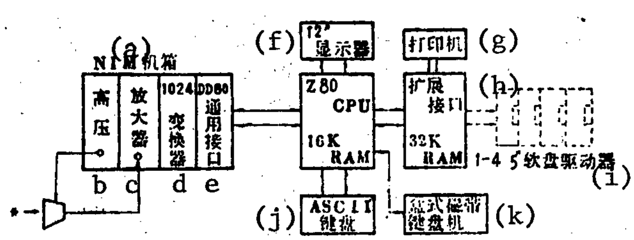
(4) Costs are low. General-purpose computers are manufactured in large numbers and the cost is low and is becoming lower every year. There is a complete range of peripherals.

II. DD80 Multichannel Structure

Taking into consideration system flexibility, the DD80 multichannel structure uses an NIM card plus microcomputer, as illustrated in Figure 1.

The signal acquisition part is made up of a probe, a high-pressure power supply, a linear amplifier, and a converter, using a standard NIM card. The microcomputer is a TRS-80I, the CRT gives a spectral-shape display, and the printer gives spectral data and has a spectral-shape output. A cassette tape drive is used for storing the program and the spectral data.

Figure 1. Diagram of Microcomputer-based Multichannel Analyzer



Key:

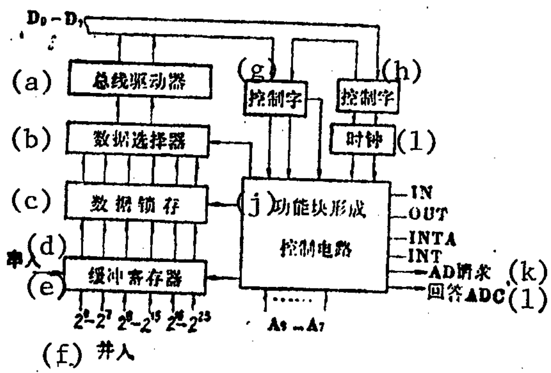
a. NIM cabinet
b. High pressure
c. Amplifier
d. 1024 converter
e. DD80 general-purpose interface
f. 12-inch display
g. Printer
h. Expansion interface
i. 1-4 5-inch floppy-disk drives
j. ASCII keyboard
k. Cassette tape keyboard

The computer's internal memory was expanded to 48K and, when necessary, one to four 5-inch floppy-disk drives can be attached. This configuration makes the selection of the signal acquisition card flexible and the computer is easy to use independently of the system.

III. Data Acquisition Interface

DD80 is a small system and to keep costs down only the interrupt-mode data transmission is used in the interface. A block diagram is given in Figure 2. Generally speaking, it is made up of three modules: data channel, control circuit, and clock circuit.

Figure 2. Diagram of General-purpose Interface



Key:

a. Bus driver
b. Data selector
c. Data latch
d. Serial input
e. Buffer
f. Parallel input
g. Control word
h. Control word
i. Clock
j. Control circuit formed of function modules
k. AD request
l. Response ADC

(1) The data channel is used to send the acquired digital information (in either serial or parallel) through the buffer register, data latch, and data selector byte by byte to the computer. To reduce loss due to dead time, a two-level data buffer is used in the interface. Thus when the input-counting rate is 10K, the system's equivalent dead time is 75 HS.

(2) To suit the characteristics of such data acquisition functions, the control circuit is divided into several general-purpose function modules which are combined by software control characters. Thus, only a few components are used, a variety of function conversions are implemented, and it is easy for functions to be expanded. The time sequence circuit in the control circuit is used to control the relay of the data from the buffer through the latch to the selector.

(3) The clock circuit produces a $\bar{Y}$MHz clock and frequency pulse, which provides fixed time, 1-second timing, and real-time and active-time control.

IV. DD80 Program Articulation

DD80 is primarily a display program. Data acquisition uses the interrupt-service program and the other functions are subprograms. The articulation diagram is illustrated in Figure 3.

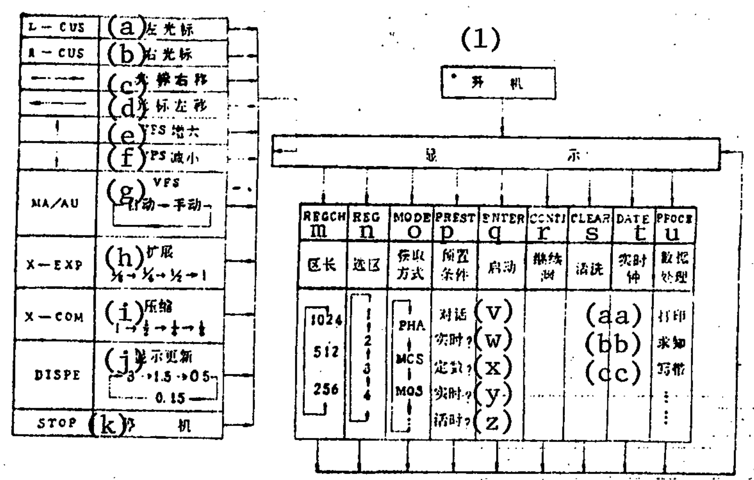
Control of the multichannel analyzer in the hardware multichannels is carried out by a special switch. For operational convenience and to avoid too much man-machine dialogue, in the microcomputer multichannel, 20 keys on the general-purpose keyboard are redefined and given new functions so that by pressing a certain function key, the subprogram can be called and its special

operations carried out. By using defined-function keys, multichannel control is very easy. As illustrated in Figure 3, after turning on the computer and entering the display state, the computer simultaneously scans the keyboard waiting for key input. After the operation of a certain function key has been completed, it returns to display. However, during data acquisition, the multichannels are in an active display state and the function keys under the display box are inactive (the computer does not scan these keys) to avoid creating confusion in functions. To monitor spectral acquisition, the keys to the left of the display box are still active. They serve the display and correspond to hardware multichannel-related display knobs.

Key:

a. Left cursor
b. Right cursor
c. Move cursor right
d. Move cursor left
e. VFS increase
f. VFS decrease
g. VFS automatic--manual
h. Expand
i. Compress
j. Renew display
k. Stop
l. Start display
m. Area length
n. Select area
o. Acquisition mode
p. Present condition
q. Enter
r. Continue
s. Clear
t. Real-time clock
u. Data processing
v. Dialogue
w. Real time?
x. Fixed number?
y. Real time?
z. Active time?
aa. Print
bb. Inquiry
cc. Write to tape

Figure 3. Diagram of DD80 Program Articulation



Please see Reference [1] for DD80 software.

V. DD80 Primary Functions

(1) Memory partition: 1x1028, 2x512, 4x256. The capacity of each channel is 106-1.

(2) The data acquisition function PHA is a pulse amplitude analysis (containing fixed time, fixed count), MCS is multiple-reference analysis, MOS is Mossbauer spectral analysis, WFS is waveform sampling analysis, MCT is multiple-timing analysis, PIA is time interval analysis, and SDI is spectral input (hardware multichannel, spectral-data input computer).

(3) Data-processing functions: spectral smoothing, automatic peak searching, energy scale, spectral integration, rewriting, nuclide qualitative analysis, and nuclear library editing.

(4) Data output functions: print data, spectral forms, and data storage tape.

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8226/8918
CSO: 4008/1014

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

BRIEFS

SHAANXI INSTRUMENT TESTING CENTER--Xian, 9 Dec (XINHUA)--China's largest center for testing pressure instruments and meters has been completed and went into operation last Sunday in this capital of Shaanxi Province. The center is a priority project undertaken by the Ministry of Machine Building. It will test, supervise, and assess the quality of pressure instruments and meters throughout China. The test center will determine if the instruments meet the quality control requirements and the application of international standards. [Text] [Beijing XINHUA in English 0717 GMT 9 Dec 85 OW] /9365

CSO: 4010/1020

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TITLE: "The Structure of ZSM-5 Molecular Sieves at High Temperature"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol 13 No 2, Jun 85 pp 106-113

TEXT OF ENGLISH ABSTRACT: The crystal structure polycrystalline sample of ZSM-5 zeolite treated with high temperature steam was determined by X-ray diffraction at 500°C. The symmetry of the crystal changed from the space group $C^5_{2h}-P2_1/n$ (at room temperature) to $C^9_{2v}-P2_1/n$ (at 500°C) and the unit cell parameters were a = 20.09(3)Å, b = 19.97(3)Å, C = 13.36(2)Å. It is interesting that when the sample was cooled to room temperature again, it returned to $C_{h}-P2_1/n$. At 500°C the three structural parameters related to shape selectivity, i.e., the size and shape of both channel opening and the bend angle of the Z-form channel, are similar to those at room temperature. Therefore, when molecules of different shapes enter the ZSM-5 channels, the steric hindrance or "potential barrier" does not change with temperature.

It is concluded that the decrease in shape selectivity of ZSM-5 is due to an increase of active molecules in iso-hydrocarbons and not to the perceptible increase in the size of both channels and openings at elevated temperatures.

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TITLE: "Investigation of the Constitution and Structure of Maoming and Fushun Oil Shales. I. Aromatic Structure of Organic Matter"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol 13 No 2, Jun 85 pp 133-140

TEXT OF ENGLISH ABSTRACT: The Maoming and Fushun oil shales were treated by 1) benificiation of organic matter with HCl and HF, 2) extraction with toluene under supercritical state (385°C, 15MPa) for converting most of the organic matter into soluble bitumens. Proton and C-13 NMR spectroscopy analysis assessed the carbon aromaticity of the supercritically extracted bitumens to be 0.32-0.34, which appears to be in fair agreement with the aromaticity determined directly using solid state C-13 NMR (CP/MAS) techniques. Other aromatic structural parameters, such as number of rings, condensation index, degree of substitution and spatial laminar regularity, have been explored based on proton NMR structural analysis and X-ray diffraction examinations. The majority of the aromatic sheets contain three to seven condensed rings, implying that they would contribute little to the oil formation during the thermal conversion of oil shales. Both of these two kerogens may be classified as immature sapropelites due to their relatively low carbon aromaticity, low degree of condensation, high degree of substitution and random spatial configuration of the aromatic sheets.

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TITLE: "The Performance of Coal Water Slurry with High Concentration and Low Viscosity"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol 13 No 2, Jun 85 pp 141-151

TEXT OF ENGLISH ABSTRACT: In this paper the effects of additives, coal from different origins and particle size distribution on the performance of coal water slurries (CWS) are described. Three additives with high efficiency, low price and wide adaptability are found. From the evaluation of CWS prepared from 10 Chinese coals, the maximum coal concentration of the slurry prepared from single-grind Fenxi coal (70 percent 200 mesh) reaches 74 percent. Its viscosity is 1680 cP and can be stored for more than 19 days without apparent sedimentation. The coal concentration can be raised to 79 percent in CWS when "double peak" particle size distribution is used.

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TITLE: "Investigation of the Catalytic Steam Gasification of Coal by Thermobalance Analyzer. I. Catalytic Steam Gasification of Carbon"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol 13 No 2, Jun 85 pp 152-159

TEXT OF ENGLISH ABSTRACT: Catalytic steam gasification of active carbon using K_2CO_3, Na_2CO_3 and $CaCO_3$ as catalysts has been investigated at 600-750°C using a thermobalance analyzer. The influences of gasification temperature and time on the reactivity of carbon, fixed carbon conversion and product gas composition are described. It is shown that the catalytic gasification can not only increase the carbon reactivity, but also lower the CO content in product gas. The order of the activity of the said three carbonates under the gasification condition used is as follows:

$$Na_2CO_3 \geq K_2CO_3 \geq CaCO_3$$

This is different from the results reported in the literature. The catalytic features of calcium carbonate are different from those of sodium and potassium carbonate. Finally, the reaction mechanism of catalytic gasification is discussed.

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TITLE: "Axial Liquid Mixing in Bubble Column and Three Phase Fluidized Bed"

SOURCE: Taiyuan RANLIAO HUAXUE XUEBAO [JOURNAL OF FUEL CHEMISTRY AND TECHNOLOGY] in Chinese Vol 13 No 2, Jun 85 pp 168-174

TEXT OF ENGLISH ABSTRACT: Axial mixing coefficients of the liquid phase in a bubble column and a three phase fluidized bed with feed and effluent of solid particles were measured in a column 45 mm in diameter and 890 mm in height by the pulse injection technique. The measurements were also taken in a bubble column, 150 mm in diameter and 3200 mm in height, to study the influence of the bed diameter on the axial liquid mixing behavior. Alumina smaller than 100 μm was used for fluidized particles, with the weight percent of the solid phase in liquid being 20 percent. Both superficial air and water flow rates varied over the range of 1-9 cm/s.

Experimental results showed that the axial mixing coefficients of the liquid phase D_L ranged from 6 to 140 cm^2/s. Under the same experimental conditions, the values of D_L in the bubble column and three phase fluidized bed are different, with their differences varying according to the experimental conditions. In the case of the bubble column, the bed diameter influences not only the value of D_L, but also greatly affects the relationship between D_L and the gas velocity as well as the liquid velocity.

It was shown that the axial mixing of the liquid phase is more significant in both the bubble column and the three phase fluidized bed when a comparison of those results was made with the calculated results of cascade perfect mixing cells.

The authors have developed a combined technique which enables on-line application of a microcomputer and successfully takes advantage of the unsteady experimental method.

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TITLE: "Determination of Trace Lithium by Graphite Furnace Atomic Emission Spectroscopy"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 561-564

TEXT OF ENGLISH ABSTRACT: Graphite furnace atomic emission spectroscopy has been used to determine trace levels of Li. The atomization temperature, time and slit width were selected and the instrumental parameters and experimental conditions were optimized. A comparison is made between standard graphite tubes and pyrolytically coated graphite tubes. It is shown that there is a difference between these types of tubes with regard to the sensitivity and optimum atomization temperature. The atomization mechanism of lithium on both tubes is discussed. The detection limit and relative standard deviation of the determination are 5×10^{-13} g and 2.3 percent respectively. (Paper received 2 April 1984.)

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TITLE: "Spectrophotometric Determination of Gallium with p-Aminophenylfluorone and Cetyltrimethylammonium Bromide"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 593-595

TEXT OF ENGLISH ABSTRACT: A highly sensitive method for the spectrophotometric determination of gallium with p-aminophenylfluorone and cetyltrimethylammonium bromide is described. The optimum pH range is 6.2 to 8.4. The maximum absorption is obtained in the presence of cetyltrimethylammonium bromide at 550 nm with molar absorptivity being 1.58×10^5 $l \cdot mol^{-1} \cdot cm^{-1}$. The molar ratio of Ga to APF to CTMAB is 1:3:3. Beer's law is obeyed in the range of 0 to 10 μg/50 ml of Ga. After separation with n-butyl acetate the common ions do not interfere. The method has been applied to the determination of Ga in lead-bearing zinciferous complex ores with satisfactory results. (Paper received 6 May 1985.)

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TITLE: "Quantitative Analysis of $Nd_xLa_{1-x}P_5O_{14}$ Crystals by Extraction Chromatography"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 601-603

TEXT OF ENGLISH ABSTRACT: La, Nd and Y in $Nd_xLa_{1-x}P_5O_{14}$ and $Nd_xY_{1-x}P_5O_{14}$ crystals were determined by extraction chromatography with P_{507} as the stationary phase with relative error of <1 percent. P in the crystals was determined by the $Mg_2P_2O_7$ gravimetric method with a relative error of <1 percent. (Paper received 19 May 1985.)

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TITLE: "Determination of Micro Gallium in Rocks by Spectrophotometry with 2-3,5-Dibromo-2-Pyridylazo) 5-Diethylaminophenol"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 611-613

TEXT OF ENGLISH ABSTRACT: Gallium reacts with 3,5-Br_2-PADAP and acetone in a buffer of acetic acid-sodium acetate at pH 4 to form a stable red complex having maximum absorptivity at 580 nm with molar absorptivity of 1.0×10^5. The ratio of Ga/Br_2-PADAP is 1:2. A gallium content of 0 to 10 μg/25 ml adheres to Beer's law. By dissociation of an alkali fusion sample and extraction with butyl acetate, gallium is separated from many matrix elements and its selectivity is considerably improved. Forty common metal ions of definite quantities do not disturb the complex and it can remain stable for 24 hours in an aqueous solution. This method has been used for the determination of micro-gallium in rocks and minerals successfully. (Paper received 11 June 1984.)

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TITLE: "Simultaneous Determination of Iron and Titanium with Tiron"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 613-615

TEXT OF ENGLISH ABSTRACT: A method for the simultaneous determination of iron and titanium at three wavelengths (385.0, 565.0 and 761.8 nm) is described. When controlled by a microcomputer, the spectrophotometer can give three data, A_{385}, A_{565} and $A_{761.8}$, in a single operation. The iron results are calculated with A_{565} and the titanium results are calculated with $\Delta A (\Delta A = A_{385} - A_{671.8})$. Compared with traditional methods, this method is simple and its sensitivity of titanium is enhanced. Satisfactory results have been achieved when using this method to analyze eight standard silicate samples. (Paper received 13 June 1984.)

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TITLE: "A New Catalytic Polarographic Wave of Te(IV) and Consecutive Determination of Trace Tellurium and Selenium in Minerals and Rocks"

SOURCE: Changchun FENXI HUAXUE [ANALYTICAL CHEMISTRY] in Chinese Vol 13 No 8, 20 Aug 85 pp 623-625

TEXT OF ENGLISH ABSTRACT: A new catalytic polarographic wave at -0.80 V appears as a tellurium complex is formed with EDTA-Pb in a tartaric solution at pH 11. The detection limit is 5×10^{-4} gml^{-1} for Te. The polarographic wave of Se will appear at -0.5 V if the solution contains $SeSO_3^{2-}$. Then the determination of Te and Se is allowed to develop. With the addition of KIO_4 the catalytic polarographic wave of Se can reach 5×10^{-4} μgml^{-1}. This method has been used to determine trace Te and Se in minerals and rocks. (Paper received 4 July 1984.)

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TITLE: "Bifurcation Diagrams in Liquid Crystal Hybrid Optical Bistability"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 8, Aug 85 pp 992-999

TEXT OF ENGLISH ABSTRACT: In this paper we report the calculation results of bifurcation diagrams in liquid crystal (LC) hybrid optical bistability. The x-A and x-x_B bifurcation diagrams and the A-x_B phase portrait are given. The symmetry of the bifurcation diagram, the sudden change and hysteresis phenomena of chaotic regions and the effect on the structure of chaotic regions caused by LC transmittance function with two peaks are observed.

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TITLE: "Hydrostatic Pressure Dependence of Gold Acceptor Levels in Si"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 8, Aug 85 pp 1068-1074

TEXT OF ENGLISH ABSTRACT: The hydrostatic pressure coefficient of gold acceptor levels E_T in silicon was measured by the transient capacitance method. Under the pressure range of 0-8 Kbar, the pressure coefficient $\partial(E_C-E_T)/\partial P = -1.9$ meV/kbar. The electron capture cross section of gold acceptor centers does not depend on the pressure within the experimental accuracy. By comparing the present results of the hydrostatic pressure coefficient with the uniaxial pressure coefficient, we conclude that the defect potential is lacking T_d symmetry. Therefore, the gold acceptor levels do not originate from simple gold substitutional or interstitial configurations in Si crystals.

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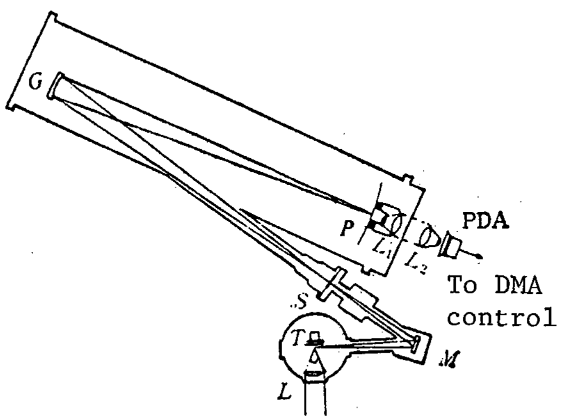
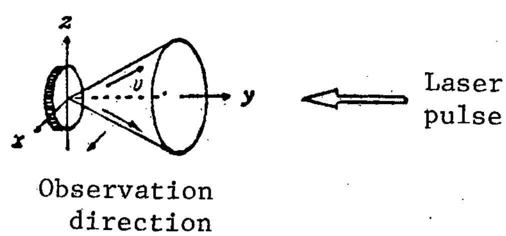
TITLE: "Spectroscopic Observations of the Line Stark Broadening in the Ultraviolet Vacuum in Laser-produced Plasmas"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 8, Aug 85 pp 1049-1055

TEXT OF ENGLISH ABSTRACT: The emission from dense plasmas produced by a Q-switched ruby laser pulse focusing on plane targets of the elements Be, C and N has been oberved in an ultraviolet vacuum at various distances from the target surface. For recording the emission spectra an intensified photodiode array and an optical multichannel analyzer have been implemented. Very broad lines of the type $\Delta n = 1$ of the H-like, He-like and Li-like ions arising from the relatively high principal quantum number n appear prominent in the spectra. According to the ion quasistatic approximation theory, the electron densities of the plasmas as the function of the distances from the target surface have been derived.





L = Aspheric surface lens
T = Target
M = Toroidal surface lens
S = Spectrographic slit
G = Concave grating
P = Rowland Grating
L_1, L_2 = Objective lens (f/0.75)

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TITLE: "A Bistable InGaAsP/InP DH Laser with Internal Modulation on Q Factor Formed by Proton Bombardment"

SOURCE: Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 34 No 8, Aug 85 pp 1102-1106

TEXT OF ENGLISH ABSTRACT: This article reports a new type of InGaAsP/InP bistable DH laser (BSDH) formed by proton bombardment with internal modulation on the Q factor. The typical bistability exhibited in the L-I curve in these BSDK's has been obtained. The current range of bistable operations is 50 mA to 200 mA, measured in two samples. The value can be varied by selecting the device parameters. It is very interesting that the laser light emitted from the BSDH operating with various injection currents has a high stable single longitudinal mode. The peak wavelength is 1.2596 μm and the stability on the wavelength is about 10^{-5}. In addition, a qualitative discussion is presented.

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